



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : B66B 23/24, G09F 19/22	A1	(11) International Publication Number: WO 00/48935 (43) International Publication Date: 24 August 2000 (24.08.00)
---	----	--

(21) International Application Number: PCT/CA00/00166

(22) International Filing Date: 18 February 2000 (18.02.00)

(30) Priority Data:  
09/252,784 19 February 1999 (19.02.99) US(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application  
US 09/252,784 (CIP)  
Filed on 19 February 1999 (19.02.99)

(71) Applicant (for all designated States except US): ESCALATOR HANDRAIL COMPANY INC. [CA/CA]; 1287 Boundary Road, Oshawa, Ontario L1J 6Z7 (CA).

(72) Inventors; and

(75) Inventors/Applicants (for US only): MCLEOD, John [CA/CA]; 4-76 Tapscott Road, Scarborough, Ontario M1B 3G7 (CA); BUGG, Ronald, L. [CA/CA]; R.R. #2, Castleton, Ontario K0K 1M0 (CA).

(74) Agent: FROST, H., Sam; Bereskin &amp; Parr, 40 King Street West, 40th Floor, Toronto, Ontario M5H 3Y2 (CA).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

## Published

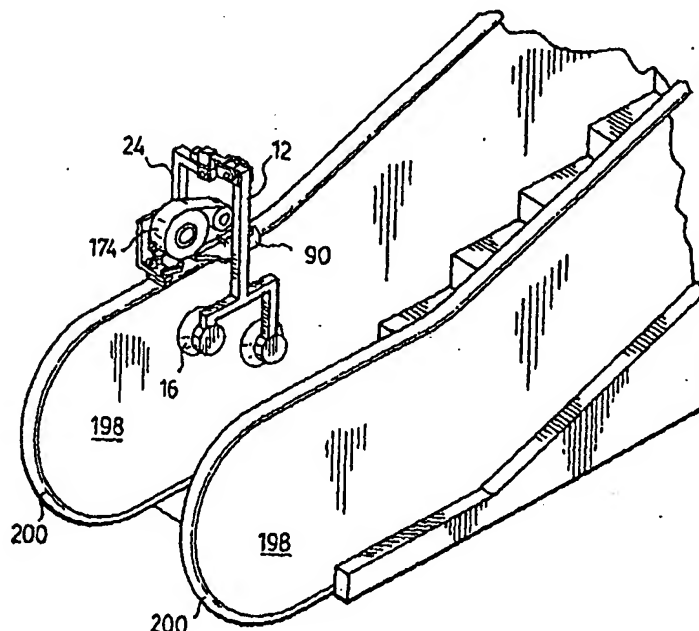
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD OF APPLYING AND REMOVING A PROTECTIVE FILM TO THE SURFACE OF A HANDRAIL OF AN ESCALATOR OR MOVING WALKWAY

## (57) Abstract

A film and a method of applying the film to a handrail of an escalator or moving walkway are provided. The film can be a single or double layered film. Printed matter, e.g. advertising, can be applied to or between the films. An apparatus and related method for applying the film are also included and rely on the motion of the handrail to unroll a supply of the film, with one or more rollers pressing the film onto the handrail.



*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

**Title: METHOD OF APPLYING AND REMOVING A PROTECTIVE FILM  
TO THE SURFACE OF A HANDRAIL FOR AN ESCALATOR OR MOVING  
WALKWAY**

**FIELD OF THE INVENTION**

This invention relates to handrails for escalators and moving walkways, and more particularly is concerned with applying a protective film, optionally including advertising or other visible material, to the surface of such a handrail.

**BACKGROUND OF THE INVENTION**

Advertisers continually seek out new locations to place advertisements. It has been recognized for sometime that various forms of mass transit and the like offer good opportunities for advertising. Necessarily, mass transit systems offer a large potential audience, and a relatively small number of well positioned advertisements can be seen by a large number of people. Travelling on mass transit is usually fairly time-consuming and hence travellers of such systems often have plenty of time to view and read advertisements, which also make such advertising attractive to businesses. This has been well recognized in the past, and advertisers have sought various locations for placing advertisements.

Escalators and moving walkways are a common component of many mass transit systems, and are also found in numerous other locations with a high level of pedestrian traffic, e.g. large office buildings, shopping malls, large stores and the like. While travelling on an escalator is relatively quick compared to, say, a subway journey, an escalator ride nonetheless presents a potential audience for advertisers. While a ride on an escalator is relatively short, it is certainly long enough for a rider to notice and read an advertisement. Moreover, it is not really practical for an escalator rider to do anything else while riding the escalator, such as read a book or newspaper.

Advertisers have long recognized this, and it is common on well-used escalators to find various advertising panels. Thus,

- 2 -

conventional poster advertising is often found lining the walls of escalator shafts. Additionally, advertisers have sought to place smaller, poster-like advertisements on smaller panels on top of the strip separating balustrades of up and down escalators. Commonly, advertisements would be placed on  
5 both sides, so as to present advertisements to riders on both the up and down escalators.

Ingenious advertisers have sought other ways of advertising on escalators. Thus, it has occurred to others that advertising could be placed on escalator handrails. This is attractive, since an escalator  
10 handrail presents an otherwise unused surface. As for grasping any object, a rider on an escalator will instinctively first look at the handrail to locate it. This ensures that the handrail, more often than not, will be at least glanced at by each user or rider. This makes it attractive for simple advertising, e.g. well known company logos and other advertising devices.

15 Thus, published Japanese application 57-130883 discloses a proposal for providing individual decals or stickers intended to be placed at regular intervals on an escalator handrail. These stickers include some sort of adhesive and a first film, and print ink applied to the rear of the first film.

20 The disadvantage with this proposal is that it requires each of these stickers or decals to be placed individually and discretely on the handrail. This is difficult, time-consuming and care would be needed to ensure that they are accurately and uniformly aligned. Moreover, each individual sticker would present a number of edges which could be caught,  
25 tending to remove it. Thus, its forward and trailing edges would present edges which could be readily caught by elements of the handrail drive mechanism. It would be appreciated that accidental removal of an adhesive sticker by the drive mechanism, so that the sticker then becomes entangled in the drive mechanism, is highly undesirable. Additionally, these edges,  
30 together with side edges of the decal would be readily visible to users, and it is believed that many users or riders of an escalator would, either deliberately, or absentmindedly, tend to pick at these edges and lift them up.

This would either tend to remove each sticker or render it more susceptible to accidental entanglement in the drive mechanism.

An alternative proposal is found in Canadian patent 1,304,035 (Andrew B. French). This proposes a relatively complex construction which would require wholesale redesign of the structure of an escalator handrail. It proposes a handrail provided with some sort of a slot or the like and a transparent cover. Advertising material is then placed between the transparent cover and the main body of the handrail. This would, in theory, overcome some of the disadvantages of the Japanese proposal. Unfortunately, this proposal totally fails to address the structural requirements of an escalator handrail. A handrail is subjected to considerable stresses and strains, and one cannot simply remove substantial sections of the handrail cross-section without addressing the structural considerations.

For example, a transparent cover could be subject to substantial tensile and/or compressive stresses, depending on the drive mechanism, and this issue is not addressed. Necessarily, this proposal requires complete replacement of each escalator handrail with one according to this invention, if advertising is to be applied.

#### SUMMARY OF THE INVENTION

A further consideration is that in many situations it may be desirable simply to provide some form of protective cover to an escalator handrail, and this is not addressed by any of the prior art proposals outlined above. First, many escalator handrails, after a period of use can develop a dull, worn appearance. Additionally, they may accidentally have various marks or discolourations on the surface, due either to the drive mechanism or the actions of users. For some situations, eg. in luxury hotels, resorts and the like, it is desirable that escalator handrails present a good appearance. Refinishing the surface of a handrail is not practical. It is therefore desirable to provide some way of applying some sort of a film to an escalator handrail, which can present a new appearance or finish to the handrail.

Accordingly, it is desirable to provide a film which can be readily applied in situ to an escalator handrail. Such a film should be capable of providing one or both of: a new, refinished appearance to the handrail; and advertising messages or logos.

5 Preferably, the film should be capable of application readily and simply, with minimum interruption in normal operation of the escalator. This should be achievable without requiring removal or replacement of the handrails.

10 Additionally, the inventors have realized that this covering should be sufficiently continuous, so as to minimize edges, etc which can promote accidental removal or entanglement in the drive mechanism. Further, this should be such as to minimize the opportunities for users to remove the surface finish or covering.

15 The invention is based on the concept of providing a film to the surface of the handrail, which film is both continuous and is removable.

In accordance with a first aspect of the present invention, there is provided a flexible film for applying to a handrail. The handrail may be a moving handrail, such as on a moving sidewalk or escalator handrail or a stationary handrail, such as would be found in a stairwell. This film comprises a first film layer with a first layer of adhesive on the underside of the first layer, and a second layer of adhesive bonding a second film layer to the top of the first film layer. The film is elongate, i.e. substantially continuous and of a uniform width adapted for mounting to a handrail.

20 This film may optionally include a layer of printed matter on top of the first layer. A release sheet layer of the same width as the film may optionally be included to protect the first adhesive layer. The first and second layers preferably comprise polyurethane with a thickness of 3 mil (0.003") and the adhesive layers comprise an acrylic-based adhesive with a thickness of 1 mil

25 (0.001").

30

In accordance with a second aspect of the present invention, there is provided an elongate handrail in combination with a flexible film

as described by the first aspect of the invention. Where the handrail is a moving handrail, the end portions of the film may overlap one another to form a spliced joint. The film may extend around the handrail and cover part of the shoulder of the handrail. For a fixed or stationary handrail, the ends of the film can simply wrap around ends of the handrail, so as not to be readily visible to a user.

In accordance with a third aspect of the present invention, there is provided a flexible film for applying to a handrail, the film comprising: a first film layer; a first layer of adhesive on the underside of the first film layer for adhering the film to a handrail, wherein the film has a width corresponding to a handrail and is elongate, whereby the film can be cut to fit a selected handrail, and wherein the film includes means for collecting contaminants from a moving handrail and associated drive mechanism.

In accordance with a fourth aspect of the present invention, there is provided an apparatus for applying an adhesive film to a moving handrail, the apparatus comprising: mounting means for mounting the apparatus to a balustrade; a first spindle means, for mounting a first roll of film; and a pressure means for applying pressure to the film to cause the film to adhere to the handrail, whereby, in use, the handrail can be driven past the apparatus, causing the film to be unrolled from the first roll with the means for applying pressure causing the film to adhere to the handrail.

It is possible that the adhesive used will not require a release sheet, and that the film could be unwound in the same manner as many commercially available adhesive tapes. Where the nature of the adhesive does require a release sheet, the apparatus may further comprise a second spindle means and a second roll for taking up a release sheet is mounted on it in use, and a drive means between the first and second spindle means. The unwinding of a film from the first spindle then causes the drive means to drive the second spindle which takes up a release sheet separated from the film leaving the roll. The drive means may comprise a gear train. The gear train can include a ratio of speeds between the first and second spindle

such that the second spindle means is driven at a faster speed than required to take up the release sheet. The apparatus then includes clutch means on at least one of the two spindle means to ensure that the tension does not become too great so as to cause the release sheet to snap, and this can then  
5 maintain a uniform tension in the release sheet.

The apparatus may include a longitudinally extending member as a main body of the actual application for applying the film, and the first and second spindles may be attached to a swing arm pivotally mounted on the longitudinally extending member. A main roller may be  
10 included in the means for applying pressure and pivotally mounted with respect to the longitudinally extending member. The main roller may be biased against the top of the escalator handrail by means of a spring.

The adjustment means may comprise pivot and sliding connections.

15 The means for applying pressure may include a pressing mechanism including a plurality of rollers mounted symmetrically about the centre line of the means for applying pressure corresponding to a centre line of a handrail. The rollers may extend from the forward end of the pressing mechanism (the forward end corresponding to the forward motion  
20 of the handrail) to the rearward end of the roller means. The pair of rollers at the rearward end of the roller means are mounted adjacent to the centre line of the apparatus and the successive pairs of rollers are mounted progressively further apart. As the moving handrail is passes through the pressing mechanism, the film is progressively wrapped around the outer  
25 surface of the handrail.

In accordance with a fifth aspect of the present invention, there is provided an apparatus for removing an adhesive film from a moving handrail, the apparatus comprising:

30 mounting means for mounting the apparatus to a balustrade;  
a first spindle means for mounting a take-up roll;  
a drive cylinder pivotally mounted to the apparatus;  
means for pressing the drive cylinder against a handrail, to



receive a drive input when the handrail is in motion;

transmission means connecting the drive cylinder to the first spindle means, for driving a take-up roll mounted on the first spindle means to wind up a film from the handrail.

5 In accordance with a sixth aspect of the present invention, there is provided a method of applying a flexible film to a moving handrail, the method comprising:

(1) providing a film comprising a first film layer and first layer of adhesive on the underside thereof, the film being generally  
10 elongate and having width corresponding to the width of the handrail;

(2) aligning and adhering a first end of the film to a surface of the handrail;

(3) driving the handrail relative to the film, to cause the film to adhere continuously and progressively to the handrail; and

15 (4) ensuring that the full width of the film is uniformly and smoothly adhered to the surface of the handrail.

The method may include providing the film on a roll and mounting the roll on a spindle adjacent to the handrail. A roller may then be applied to the surface of the handrail to press the film against the  
20 handrail. The method may further comprise progressively wrapping the film around the lips of the handrail by means of pairs of rollers mounted further apart around the outside of the handrail. The method may further involve the use of an apparatus as described in the third aspect of this invention.

25 In accordance with a seventh aspect of the present invention, there is provided a method of removing an adhesive film mounted on a handrail, the handrail being mounted for movement relative to a balustrade, and the method comprising:

(1) mounting an apparatus to the balustrade including a  
30 drive cylinder and a spindle for a take-up roll;

(2) mounting a take-up roll on the spindle and pressing the drive cylinder against the surface of the handrail;

- 8 -

(3) manually detaching an end portion of the adhesive film and engaging the end portion with the take-up roll;

(4) driving the handrail, thereby to transfer drive to the drive cylinder, and in turn to cause rotation of the take-up roll to wind up  
5 the adhesive film;

(5) after the entire adhesive film has been removed from the handrail, stopping the handrail and removing the roll with the wound up adhesive film from the apparatus.

In accordance with an eighth aspect of the present  
10 invention, there is provided a method of removing contaminants from a drive mechanism of a handrail, the handrail being mounted for movement relative to a balustrade and the drive mechanism being incorporated into the balustrade, and the method comprising:

(1) mounting a film to the handrail, the film  
15 comprising: a first film layer; a first layer of adhesive on the underside of the first film layer for adhering the film to a handrail the film having a width corresponding to the handrail and being elongate, and the film including means for collecting contaminants from a moving handrail and associated drive mechanism;

20 (2) driving the handrail to cause the film to pass through the drive mechanism, thereby to cause contaminants to be picked up by the film;

(3) after a period of time, stopping the handrail and removing the film from the handrail.

25 The film has a width corresponding to the handrail in the sense that its width is selected depending on the width of the handrail, but its actual width could be substantially less than that of the handrail so that it only covers part of the handrail.

### 30 BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show more clearly how it may be carried into effect, reference will now be

made, by way of example, to the accompanying drawings which show the preferred embodiment of the present invention and in which:

Figure 1 is perspective view of an apparatus in accordance with the present invention for applying a film to an escalator handrail;

5                Figures 2a and 2b are side views of the apparatus of Figure 1, in different positions;

              Figures 3a and 3b are views along the length of a handrail, showing alternative mounting arrangements;

10              Figure 4 is a perspective view showing the apparatus in use on a balustrade of an escalator corresponding to figure 3a;

              Figure 5 is a perspective view showing the detail of motion of the film and a release sheet showing application of film to an escalator handrail;

15              Figures 6a and 6b are detailed views of a spindle for mounting a roll, for either the film or the release sheet;

              Figures 7a, 7b and 7c are schematic views showing paths of the film and release sheet and wrapping of the film around the handrail;

              Figures 8a and 8b are cross-sectional views through a pressing mechanism, showing operation thereof;

20              Figure 9a-9f are further cross-sectional views through a pressing mechanism, showing mounting of pressing rollers;

              Figure 10 is a side view of the pressing mechanism, showing details of one-half of the trough-shaped pressing mechanism;

25              Figures 11a-11f are views showing details of the spacing mounting of the rollers of the pressing mechanism;

              Figure 12 is a cross-sectional view through a film according to the present invention;

              Figure 13 is a perspective view of a mechanism for aligning the apparatus of the present invention;

30              Figure 14 shows a perspective view of an apparatus for removing a film from a handrail, the apparatus being shown in use on a handrail;

- 10 -

Figures 15a, 15b and 15c show, for part of the apparatus for removing a film of Figure 14, a perspective view from the other side, a side view and a perspective view similar to Figure 14, all on an enlarged scale;

Figure 16 shows a sectional view through the apparatus of  
5 14 and 15; and

Figure 17a-17d show plan views of examples of perforation patterns for a film for a handrail.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

10 Referring first to Figures 1 and 3a, an apparatus in accordance with the present invention is indicated generally by the reference 10. The apparatus 10 includes a main support member 12, of tubular, square cross-section. The support member 12, at its lower end is of inverted T-shape and includes two downwardly extending portions 14 of  
15 different lengths. At the lower end of each portion 14, there is mounted a suction cup 16. If required, the support member 12 can be offset laterally (Figures 3a, 3b), to locate the apparatus in the desired position relative to a handrail.

At the upper end of the support member 12, there is a pivot  
20 connection 18, providing a connection to a first cross member 19. In known manner, the pivot connection 18 includes overlapping flanges secured to the members 12, 19, and a nut and bolt adjustable to clamp the flanges together.

Mounted on the first cross member 19 is a sliding swivel  
25 joint 20 which includes a bracket slidable along the first cross member 19. A threaded screw member 21 enables this bracket to be clamped relative to the cross member 19.

The bottom end of the bracket of the swivel joint 20 includes a second pivot connection 22 to a second cross member 23.  
30 Similarly, this pivot connection 22 can be locked or secured by means of a nut and bolt arrangement. A downwardly extending member 24 extends from one end of the second cross member 23.

- 11 -

The overall arrangement of the members 12, 19, 23 and 24, the pivot connections 18 and 22 and the sliding swivel joint 20 is to provide desired degrees of freedom for the lower end of the downwardly extending member 24, both vertically and horizontally, i.e. in the plane of Figures 3a and 3b. As the actual applicator of the present invention (to be detailed below) is mounted at the lower end of the member 24, this enables the applicator to be adjusted to a desired location relative to a handrail. Thus, the pivot connections 18, 22 enable the vertical location to be adjusted, and this adjustment will necessarily cause some lateral or horizontal movement of the lower end of the downwardly extending member 24. The sliding joint along the cross member 19 enables the horizontal location to be adjusted.

Figures 1 and 3a show one mounting arrangement, in which the cross members 19, 23 have their free ends extending in general opposite directions. In an alternative mounting arrangement the vertically oriented members 12, 24 are located close together, with the free ends of the cross members extending in the same direction away from the members 12, 24.

In general, the apparatus will always be mounted on the inside surface of a balustrade 198, and often, the balustrade will not present an accessible outer surface. Thus, both the arrangements of figures 3a and 3b will be required for the two handrails on either side of an escalator or moving walkway.

The lower end of the downwardly extending member 24 is connected to a longitudinally extending member 32 (this is described as longitudinally extending, in relation to the escalator handrail, as will become clear from the description below), which forms a main body of the actual applicator for applying the film.

A rearward end of the member 32 is secured to an L-shaped bracket 34. Further cross members 36, 37 extend perpendicularly out from the longitudinally extending member, at the middle and forward end thereof. A projecting lug 38 is mounted on and extends upwardly from the

- 12 -

longitudinally extending member 32, between the cross members 36 and 37.

The L-shaped bracket 34 includes a horizontal element 40. A rear roller 41 is mounted on two lugs 41a extending downwards from the rearwards end of horizontal element 40. A small frame 42, comprising a pair of parallel and spaced side members and joining cross member, is pivotally mounted to two small lugs 44 projecting upwardly and forwardly from the front end of element 40. A roller 46 is rotatably mounted between the free ends of the side members of the frame 42.

Referring now to Figures 1, 2a and 2b, to bias the frame 42, and hence the roller 46, downwards, there is provided a spring mechanism 47 mounted to a vertical element 50 of the L-shaped bracket 34. The spring mechanism 48 includes a helical coil spring 48a (Figure 1), a plunger 52 and upper and lower discs 49a and 49b. The plunger 52 is pivotally connected at its lower end to a side projection from the frame 42. The bottom of the helical coil spring abuts the lower disc 49b, while the top end of the spring 48a abuts the upper disc 49a. The lower disc 49b is fixably mounted to plunger 52, while the upper disc 49a is slidably mounted on the plunger. The upper disc 49a is also pivotally attached to a vertically-directed crank member 54. Crank member 54 is attached via a crankshaft (not shown) to a horizontally-directed handle 56 on the opposite side of vertical element 50, with the crankshaft rotatably mounted in a bore of the element 50. When handle 56 is horizontal and pointing rearwards (as in Figure 2b), the crank member 54 is pointing downwards, compressing the spring 48a. The compression of the spring 48a biases frame 42 downwards. Handle 56 is kept in place by means of ratchet 58. When the ratchet is released and handle 56 is rotated to a forward-pointing horizontal position, crank member 54 is pointing upwards, releasing the compression in the spring (as in Figure 2a). The ratchet 58 is pivotally mounted in an opening in the vertical element 50, so that it can be displaced away from the handle 56, to release the handle.

A swing arm 60 is pivotally mounted to the projecting lug 38 and includes a spacer element 62, so as to space the swing arm away from the longitudinally extending member 32, for reasons which will become

clear below. Swing arm 60 may comprise two separate members 60a and 60b fixably attached via a joint 61. Swing arm 60 may be locked into a horizontal position as shown in Figure 2a by means of a simple locking mechanism 63. Locking mechanism 63 is a simple L-shaped member where one end is  
5 pivotally mounted on longitudinally extending member 32. The other end abuts the bottom portion of the swing arm preventing the arm from falling. Swing arm 60 may be unlocked by pivoting the locking mechanism 63 away from swing arm 60.

First and second spindles 64, 66 are rotatably mounted to  
10 the swing arm 60, and details of the spindle 66 is given below in relation to Figures 6a, 6b.

The first spindle 64 is secured to a drive gear 68, while the second spindle is secured to a driven gear 70. An idler gear 72 is rotatably mounted to the swing arm, so as to engage both the drive and driven gears  
15 68, 70. The drive gear 68 is substantially larger than the driven gear 70, so as to ensure that the second spindle 66 is driven at a faster speed than that of the first spindle 64.

The arrangement of the spindles 64, 66 and the roller 46 is intended to apply an adhesive film to the top surface of the handrail. To  
20 ensure that the film is applied uniformly around the side edges and at least partially underneath a handrail, a pressing mechanism 90 is provided. The pressing mechanism comprises a trough-shaped element 92 having first and second halves 92a, 92b. Each of the element halves 92a, 92b includes elements 94 that combine to form shallow slots or sleeves. Extending  
25 downwardly from each of the cross members 36, 37 is a support member 96 having, in cross-section inverted T-shape, so as to present edge portions engaging the sleeves formed by the elements 94. This mounts the trough-shaped element halves 92a, 92b, for sliding movement laterally, while otherwise limiting their movement.

30 As best seen in Figures 1, 8a and 8b, an over-centre mechanism 100 comprises a first arm 101 and a second arm 102 pivotally mounted to the trough-shaped element halves 92a, 92b respectively. The

second arm 102 forms an obtuse angle and is formed from two generally parallel side members. The free end 104 of the second arm 102 provides an actuating handle. The first arm 101 is pivotally attached to the second arm 102, generally at the obtuse angle therein. In known manner, if the handle end 104 is raised and pivoted towards the longitudinally extending member 32, this causes the trough-shaped elements 92a, 92b to slide apart along the inverted T-shaped member 96 (Figure 8b). When the handle end 104 is displaced to the position shown in Figure 8a, then the trough-shaped halves 92a, 92b are drawn together to the position shown. The first arm 101 includes a nut 105 and bolt 105a assembly as shown in Figures 8a and 8b. The nut 105 is used to shorten the first arm 101. The shortening of the first arm 101 causes trough elements 92a and 92b to come closer together when in the closed position. This enables adjustment of the width of the trough 92 for handrails of different dimensions.

Referring now to Figures 1, 9a-9f, 10 and 11a-11f, a series of rollers 110, 111, 112, 113, 114, and 115 are rotatably mounted on roller mounting mechanisms inside each of the element halves 92a, 92b. Rollers 110-115 are mounted such that the rollers 110 are relatively close to the centre line of the apparatus and to the centre line of the handrail. Rollers 110 are mounted towards the rear of the element halves 92a and 92b at position 110a (Figure 10). The other rollers 111, 112, 113, 114, and 115 are located progressively further away from the centre line and progressively closer to the front of the mechanism at positions 111a, 112a, 113a, 114a, and 115a respectively, for progressively wrapping a film around the handrail. Rollers 110 to 113, shown generally as 210 on roller mounting mechanism 212 (Figures 11a, 11d), are mounted on a frame 214. The frame 214 comprises two side members 216 and three cross members 218, 220 and 222. The roller 210 is rotatably mounted on cross member 218. The frame 214 is pivotally mounted on two lugs 224 extending from the base 226 of roller mechanism. A helical torsion spring 228 is mounted on cross member 222. One end of the spring is pressed against the base 226 and the other end is pressed against cross member 220. Spring 228 thus acts to bias frame 214 and roller 210.



- 15 -

inwardly towards handrail 200. The base 226 is mounted to a respective trough-shaped half 92a, 92b.

Referring mainly now to Figures 11b, 11c, 11e, and 11f, rollers 114 and 115 are similarly mounted within roller mounting mechanisms with some exceptions. First, rollers 114 and 115 have smaller diameters than rollers 110-113. As well, rollers 114 and 115 are spaced laterally away from spring 228 with spacing elements 230. Both of these differences are designed to allow the rollers to press the film against the shoulder of the handrail where space is limited.

As best shown in Figures 2, 9e, 9f and 10, the trough-shaped element halves 92a, 92b include a forward extension 116. Mounted to each of these extensions 116 are brackets 118 and 119. Rollers 114 are rotatably mounted to the first brackets 118 and rollers 115 are rotatably mounted to second brackets 119.

Reference will now be made to Figure 6a and 6b, which show details of a clutch mechanism for the spindle 66 and friction mounting mechanism for both spindles 64, 66. Each of the spindles 64, 66 includes a rotatably mounted spindle body 120, each of which is attached to a respective gear 68, 70. However, only spindle 66 includes the clutch mechanism.

The spindle body 120 of spindle 66 includes an internal tubular bearing 122 mounted on a shaft 124. The shaft 124 has an enlarged head 126. A helical coil spring 128 is mounted between the enlarged head 126 and a washer 130 abutting the end of the bearing 122. The coil spring 128 presses the spindle body 120 against the gear 70 mounted on the shaft 124.

The shaft 124 extends through a bearing hole 134 in the swing arm 60, and washers 136 are provided on either side of the swing arm 60. The washers 136 are secured to, or integral with the shaft 124.

Within the spindle body 120, there is a lever 138 including a projecting lever end or actuation portion 140. The lever 138 is pivotally mounted at 142 and a spring 144 biases the lever radially outwards. Bearing projections 146 extend radially out through openings in the tubular spindle

body 120.

Accordingly, in use, as shown in Figure 6a, to mount a roll 150 for taking up a release sheet from a film, the lever end 140 is pressed radially inwards, to bring the projections 146 radially inwards. This permits  
5 the roll 150 to be slid onto the spindle 66. With the roll 150 in position, the lever 138 can be released. Then, the spring 144 acts to press the bearing projections 146 against the inside of the roll 150 securely mounting the sleeve. Torque can then be transmitted between the sleeve 150 and the spindle body 120.

10 The arrangement of the spring 128 and related elements of the spindle 66 acts as a clutch to limit torque transmission between the tubular spindle body 120 and the shaft 124. In particular, the drive ratio required between the two spindles 64, 66 will vary as the size of the rolls on the two spindles varies. It is impossible to maintain a completely accurate  
15 ratio at all times. Accordingly, the ratio between the drive and driven gears 68, 70 is such as to ensure that, at a minimum, the second spindle 66 is driven at a slightly faster speed than required, for all effective sizes of rolls on the spindles 66 (the effective size being the diameter of the roll at any instant including material wound on it). Then, any excess speed is,  
20 effectively, dissipated by the clutch mechanism in the spindle 66. In use, this will maintain a constant torque tending to wind up the release sheet.

Reference will now be made to Figures 4, 5, 7, 8, 12 and 13 to describe a preferred film configuration and method of using the apparatus of the present invention.

25 Referring first to Figure 12, there is shown, schematically, a cross-section of a film in accordance with the present invention. This cross-section is shown transverse to the longitudinal direction of the handrail. This film is indicated at 160 and comprises a first film layer 162 with a first adhesive layer 164 on the underside thereof. To protect the film  
30 until this is applied and to enable the film to be wound up onto a sleeve 150, a release sheet 166 is provided in known manner.

On top of the first layer 162, printed matter is provide as

indicated at 168. This printed matter can be text, logos, images, etc., and it is expected that it will often comprise a repeated pattern. Shown schematically, this printed matter would have a negligible thickness, so as not to significantly affect the thicknesses of other layers. This printed matter  
5 168 is printed directly onto the top of the first film layer 162.

Following application of printed matter 168, a second film layer 170 with a respective second layer of adhesive 172 is applied to the top of the first sheet, so as to sandwich the printed matter 168 between the two film layers 162, 170. This serves to protect the printed matter.

10 Each film layer 162, 170 is preferably a polyurethane film having a thickness of 3 mils. The film is preferably a high gloss, clear flexible film, coated with a clear acrylic pressure sensitive adhesive. These films are provided with a release liner. Thus, once the top of the first film layer 162 has been printed, the second film layer 170 with its associated  
15 adhesive 172, after the release liner or sheet removed, is then applied to the top of the first film layer 162 to form the combined film 160 shown in Figure 8.

The width of the film as supplied is commonly several feet. For the present purposes, it would be cut to widths depending upon the  
20 particular handrail application.

While it is expected that the first and second film layers 162, 170 would both be clear, for some applications, it may be desirable to colour the second film layer 170. Thus, the second layer 170 could be a solid, uniform colour to provide a suitable background to advertising material or  
25 a manufacturer's logo, and this colour could be a colour associated with the particular product or manufacturer. Additionally, the first film layer 162, if desired, could be provided with some tinting.

Another aspect of the invention is the use of a film simply to protect a handrail for an escalator or moving walkway. For this purpose,  
30 the film 160 could have a single layer. For such an application, the second film layer 170 and its adhesive 172 could be omitted. For completeness, it is noted that, conceivably, in such applications, some printed material could

- 18 -

still be provided on the top of the first film layer 162, but such printed matter would not then be protected, and would likely be subject to excessive wear, marking, etc. during passage through the handrail drive mechanism.

Reference will now be made to Figure 13, which shows an alignment mechanism 180, which essentially comprises a five-member pivoted parallelogram mechanism. The mechanism 180 comprises a pair of side elements 182, pivotally attached to a pair of transverse elements 184. a central element 186 extends longitudinally, parallel to the side elements 182, and is pivoted to the transverse elements 184. Tension springs 188 may be omitted. If the springs 188 are omitted, it is a simple matter to hold the unit by hand and provide the closing tension required to centre the mechanism mounted between the central element 186 and ends of the transverse elements 184. The tension springs 188 act to bias the side elements 182 together, tending to collapse the parallelogram formed by the elements 182, 184.

Mounted on the central element 186 is a light source 190, here a laser. The laser 190 is mounted in a bracket 192 pivotally mounted to the central element 186.

Pivot connections between elements 182, 184 are formed by pivot pins, one of such is indicated at 194. Each pivot pin 194, beneath the respective side element 182 is provided with a cylindrical collar 196.

A description will now be given of the use of the equipment of the present invention. Firstly, before a film is applied to a handrail, the handrail must be properly prepared. Most handrails, after a period of use, will acquire a film of dirt and grease, preventing proper adherence of an adhesive film.

Accordingly, the handrail is first washed with a solvent, preferably an EH-101 solvent blend to remove all dirt and grease. EH-101 solvent blend is composed of ethyl acetate, naphtha, toluene and benzene. For this purpose, operators should wear rubber gloves and use appropriate applicators.

The handrail is then inspected for gouges or defects that

impede application. If deep gouges are present, the handrail may need to be replaced before the film is applied.

Any deep stains or marks can be removed with a scrub pad and EH 101 solvent blend.

5           The handrail is cleaned by first cleaning an exposed run of the handrail, and both handrails of an escalator or moving walkway could be cleaned simultaneously. Each run is then marked with a china marker. The drive mechanism of the escalator is then used to jog the escalator and its handrail, to the end of the marked and cleaned areas, to expose further  
10 stretches of the handrails. This procedure is repeated, and until the entire length of both handrails of an escalator are cleaned.

Once clean, the handrail is coated with a sealant, to reduce slightly the adhesive bond between the film and the handrail. This ensures that the applied film can be peeled off readily. An appropriate sealant is  
15 applied as specified, generally as a thin film. The film of sealant is buffed to a smooth, shiny finish. Again, the handrails on two sides of an escalator can be treated simultaneously. The handrails are marked with a china marker to indicate areas that have been sealed, and then jogged forward using the escalator drive mechanism; this is repeated until both handrails are treated  
20 and sealed.

To provide a film for an escalator, two matched rolls of film are provided, one for each handrail. The handrails have the film applied separately. Theoretically, it may be possible to apply both films simultaneously, but this is usually not practical. It has been found that  
25 application of the film needs to be monitored carefully, and, on occasion, adjustments and the like are required. To monitor two films simultaneously would be difficult.

For an escalator, an operator is provided with two matched rolls of film, one for each handrail; the handrail is indicated at 200 and its  
30 balustrade at 198 in the drawings, while the rolls of film are indicated at 174. First, the operator should confirm that the correct rolls 174 are present for the particular site or escalator. The wind configuration of the rolls should be

checked. Commonly, most advertising material should be viewed from one direction, and should be applied in the appropriate orientation, for each of up and down escalators.

5 The apparatus 10 is then mounted to the balustrade 198, shown in Figures 3 and 4, with just the support member 12 attached, i.e. with the cross member and attached components removed. The apparatus 10 is preferably mounted at the top of the escalator for down escalator units and at the bottom of the escalator for up escalator units. On installations where obstacles prevent mounting at these locations, it is permissible to  
10 attach the apparatus 10 away from the ends on a straight, sloped portion of the handrail.

The vacuum cups 16 are pumped up, in known manner, to securely mount them to the balustrade. With the support member 12 securely mounted, the rest of the apparatus or the applicator is mounted by  
15 sliding the swivel joint 20 onto the first cross member 19, in accordance with figure 3a or Figure 3b as required.

The swing arm is raised into the retracted position with the locking mechanism 63. A roll of film 174 is then mounted on the first spindle 64. This is mounted as shown in Figures 6a and 6b and as detailed  
20 above.

The apparatus 10 is mounted on the balustrade 198 with the trough-shaped pressing mechanism 90 in the open configuration (Figure 8b). The pressing mechanism 90 is then closed. With the pivot connections 18, 22 and the sliding swivel joint 20 loosened as required, the horizontal  
25 and vertical position of the apparatus is adjusted. The rear roller 41 and rollers 110-115 serve to ensure that the apparatus is accurately located relative to the handrail. If required, the nut and bolt assembly 105, 105a is adjusted. With the apparatus properly located, the pivot connections 18, 22 and the sliding swivel joint 20 can be locked. Final angular adjustment is  
30 achieved using a bubble level.

Alignment and clearances should then be checked. The alignment can be checked using the mechanism shown in Figure 15. For

this purpose, the centre line of the release sheet 166 is measured and marked with a ruler and pen, or the release sheet can be provided with a preprinted centre line. First, side elements 182 of the alignment mechanism 180 are grasped and displaced sideways and the mechanism 180 fitted onto  
5 the handrail 200. The side elements 182 are then released, so that the springs 188 cause the mechanism 180 to snugly abut the sides of the handrail 200. This will automatically align the laser 190 with the centre of the handrail. The angular position of the laser 190 can be adjusted if desired.

The position of the laser beam relative to the centre line  
10 mark will indicate whether roll 174 is properly aligned. If necessary, the roll position can be adjusted, depressing spindle lever 140 to release the spindle tension and sliding roll 174 until the mark and laser coincide. The laser guide is then removed from the handrail.

The swing arm 60 is locked in place using locking  
15 mechanism 63 and the pressing mechanism 90 is opened. The roller 46 is placed in the retracted position as shown in Figure 2a by turning handle 56 to the forward direction. This causes the crank member 54 to point upwards and the roller 46 to lift above the handrail. With roll 174 in place, the end 160a of the film is fed around the retracted roller 46 and pulled manually  
20 through the open press mechanism 90 and directed along the length of the handrail. The tail end of the film is wrapped around the sides of the handrail, after peeling back a corresponding length of the release sheet 166. The adhesion at this point allows for wrinkles and air pockets. The pressing mechanism 90 is then closed and release sheet 166, peeled off the film 190, is  
25 directed around and above the roll 174 and secured by tape to a take up roll 178. The roll 178 is mounted on the spindle 66. The crank is released from the ratchet 58 and rotated 180° and the crank member 54 now points downwards relative to the crankshaft and the roller 46 is pressed by the spring into contact with the handrail 200 (Figure 2b). The swing arm 60 is  
30 then unlocked so that the roll 174 abuts and tracks against roller 46. The weight of the swing arm adds to the force applied to the film during application.

Once the film 160 contacts the handrail 200, this can be jogged a short distance, to establish the thread-up and confirm the centre alignment. The edges of the film should be even and symmetrical on the handrail shoulders. If not, the position of roll 174 can be adjusted.

5           The leading portion of the film 160 adjacent the end 160a is then manually wrapped around the handrail 20, to the configuration shown in Figures 7c, ensuring that no bubbles are formed or left under the film. The pressing mechanism 90 is then closed, and the escalator jogged to run a test strip of approximately five feet to ensure that no bubbles or  
10 wrinkles are formed. The pressure applied by roll 46 can be adjusted by turning a nut (not shown) below spring 48a on plunger 52. Roll pressure within press mechanism 90 is adjusted by turning the bolt 105a which varies the closing of the two halves of the pressing mechanism.

Once it has been established that the apparatus is properly  
15 centered with adequate clearances and that the film 160 is being applied uniformly without wrinkles, bubbles, etc., then the escalator can be operated to run the film around the entire length of the handrail.

The operator watches for the end 160a of the film to come back towards the apparatus 10. End 160a, which was pressed down by hand,  
20 passes underneath the roller 41 which helps ensure that the film was adequately pressed onto the handrail. Once end 160a returns to the mechanism, a portion of the film is allowed to overlap the end 160a by approximately 12 inches.

At this time, the swing arm 60 is raised, and pressure on the  
25 roller 46 is released by engaging the handle 56. The pressing mechanism 90 is opened. The film is cut. The threaded screw member 21 is loosened to permit removal of the upper portion of the apparatus 10 from the support member 12. The support member 12 with the vacuum cups 16 is then removed separately.

30           An overlap splice is then prepared by pulling up 3 to 4 inches of the excess film. This is trimmed cleanly at a 90° angle. It is then smoothed down by hand ensuring that no bubbles or wrinkles are present.



It can be noted that this splice joint is such that the natural action of rollers and other drive elements contacting the handrail will tend to smooth down the joint, rather than tending to lift up the end of the film.

It is recognized that where the film 160 bears advertising, it would almost certainly be intended that a particular application only be left on an escalator for a set period of time. Indeed, rates for advertising on escalator handrails will almost certainly be determined on a time basis.

When a particular advertiser's time has ended and it is desired to replace the film, then the existing film needs to be removed. To do this, the escalator is stopped with the film splice exposed on one handrail (it is expected that each handrail will need to be stripped separately). The end of the film is peeled up, to reveal the end last applied to the handrail. This end can then be peeled off itself. If the film peels cleanly, then the escalator can be started and the strip removed continuously while standing at the top or bottom of the escalator.

If the film 160 leaves any residue on the handrail 200, then it is preferred to proceed more slowly and to strip the handrail 200 carefully, to reduce the clean up time. In this case, it is preferred to leave the escalator turned off and from a lower angle, peel the film from the lip area to the top face in small steps and clean adhesive off as one proceeds.

Any remaining adhesive left on the handrail should be removed. To remove adhesive, EH 101 solvent blend, acetone, Oil Flo or Liftoff or other suitable solvent should be used, and again in accordance with manufacturers' instructions.

Even for a handrail that has had a film applied before, it should then be washed and sealed as detailed above.

Reference will now be made to Figures 14, 15 and 16, which show an apparatus, generally indicated at 210, for peeling or removing a film from a handrail. Here, a balustrade 212 of a moving walkway or the like is shown, by way of example, with a handrail indicated at 214, in cross-section.

The apparatus 210 has a pair of suction cups 216, which can

correspond to the suction cups 16 of the earlier embodiment. A support arm 218 is provided extending out from the suction cups 216, corresponding to the support member 12. A longitudinal member 220 has a general L-shape and is mounted to the support arm 218. The member 220 includes a  
5 downwardly extending end portion 222, so as to have an overall L-shape.

Pivotaly mounted to the downwardly extending portion 222 is a yoke 224. A pin 226 extends between side arms 228 of the yoke 224 and a drive drum or cylinder 230 is rotatably mounted on the shaft 226. A first drive gear 232 is securely mounted to the shaft 226. A first clutch plate  
10 234 is attached to a pressure plate 236 which is mounted for sliding movement on the shaft 226 and is provided with splines or the like to cause it to rotate with the shaft 226. A second clutch plate 235 is secured to the drive drum 230. A spring 38 is provided for pressing the two clutch plates 234, 236 together, and acting between one arm 228 and the pressure plate  
15 236.

Consequently, in use, as the drive drum 230 is rotated, as detailed below, it transfers drive through the two clutch plates 234, 236 to the shaft 226. This in turn drives the first drive gear 232.

A swing arm 240 is freely, pivotaly mounted on the shaft  
20 226. An idler gear 242 is pivotaly mounted to the middle of the swing arm 240. A further shaft 244 is pivotaly mounted to the other end of the swing arm 240.

A second drive gear 246 and an associated first spindle 247 are secured together and to the shaft 244.

25 To maintain necessary pressures, telescopic shafts with bias springs are provided, as indicated at 248, 249. The shaft 248 is pivotaly connected to the longitudinally extending member 220 and to a side arm of the yoke 224. The second telescopic shaft 249 is pivotaly connected between the longitudinally extending member 220 and the swing arm 240 to  
30 maintain a take-up roll (detailed below) pressed against the handrail.

In use, the apparatus 210 would be mounted as shown in Figure 14. It would be mounted with the drive roller 230 pressed against the

top of the handrail 214, by suitable adjustment of the vacuum clamps 216 and the support arm 218. A take-up roll 250 is mounted on the spindle 247 in such a manner that torque or drive is transmitted between them. The handrail would then be driven in the direction of the arrow 252 causing the  
5 drum 230 to rotate. The drive gears 232 and 246 are sized so that the surface of the take-up roll 250 is moving at a greater speed than the handrail 214. It can be noted that, as detailed below, film is continuously wound on the roll 250, so that this surface or circumferential velocity will increase, for a constant angular velocity. The clutch mechanism, formed by the clutch  
10 plates 234, 235 is designed to compensate for this difference in speeds, as for the apparatus described above, and to maintain a constant torque on the take-up roll 250.

As shown, with a film 254 present on the handrail, a free end 256 of the film is first manually detached from the handrail and wound  
15 sufficiently around the roll 250 to be secured thereto.

Consequently, as the handrail 214 is driven in the direction 252, the mechanism of the apparatus 210 continuously removes the film 254 and winds it up on the roll 250. This is continued until the entire film has been removed. At this time, the apparatus 210 can then be used to remove  
20 the film on the opposite side of the moving walkway or escalator, in known manner. It will be appreciated that, for this purpose, the support arm 218 is configured to enable the apparatus to be mounted to both sides of escalators and moving handrails.

It has been found that, for a five-inch wide film, the peel  
25 strength or load required is 35 pounds (155 Newtons). This is a substantial load, and in some cases, it may cause slipping of the handrail drive mechanism, particularly where it has been set up with relatively low tension levels. For these situations, it is envisaged that the drive drum 230 can be provided with a separate power source, e.g. an electric motor, to  
30 ensure adequate driving of both the apparatus 210 and the handrail during film removal. Alternatively, the drive drum 230 can be omitted and a separate drive connected directly to the spindle 248.

- 26 -

It is also envisaged that the apparatus 210 could be integral with the apparatus 10. For this purpose, the support member 12 and the support arm 218 could be integral with one another, and an appropriate number of suction cups 16, 216 could be provided. For a combined  
5 apparatus, two suction cups may be sufficient, or it may be desirable to provide more than two.

Then, the longitudinally extending member 32 of the apparatus 10 and the longitudinally extending member 220 of the peeling or stripping apparatus 210 can be integral with one another, so as to provide an  
10 integral device or apparatus. Such a combined apparatus would enable simultaneous stripping or removal of one film and mounting of a new film, replacing the older film. Clearly, this is only acceptable in cases where stripping of the film leaves the handrail sufficiently clean, without undesirable traces of adhesive and the like.

15 In such a combined apparatus, it is believed that the problem of accidental stalling of the handrail will be more acute, due to the increased load required to both remove an existing film and lay down a new film. For this purpose, it may be more desirable to provide some separate drive, from an electric motor or the like, to drive the equipment.

20 Reference will now be made to Figures 17a-17d, which show examples of perforation patterns for incorporation in the film of the present invention. It is proposed to provide the film with a relatively strong adhesive, but as will be explained, it is believed that this could cause problems and for this reason perforations are provided. When the adhesive  
25 is functioning properly, this will ensure that the film remains in position, does not tend to become removed and entangled with the drive mechanism. Nonetheless, it must be recognized that, for a variety of reasons, the edge or end of the film, or other portions, of the film could become detached for one reason or another.

30 In this context, it is to be appreciated that the film presently proposed for the present invention has significant strength, and indeed has a 250-pound break strength across a 5-inch (approx. 12.5 cm) width. If an

edge of the film becomes detached, it could become entangled with part of the drive or guidance mechanism of the handrail. Conceivably an end of the film could become wrapped around a guide roller and it could progressively remove the entire length of the film and cause it to wrap  
5 around the roller; likely the mechanism would jam before the entire length had been removed. In any event, this is highly undesirable and would present a significant maintenance problem. In this context, it is noted that the present invention is intended for operation by relatively low-skilled personnel, or at least personnel that need no detailed knowledge of an  
10 escalator or handrail drive mechanism. Such personnel would not have the skills necessary to deal with a major entanglement of the film about part of the drive or guidance mechanism.

Accordingly, with the intention of avoiding this problem, it is proposed to weaken the film, by means of perforations. The intention is  
15 that if any edge does become free so as to adhere to part of the drive mechanism etc., the film should enable a small portion of the film to become detached from the handrail, by the film separating at lines or perforations. This should ensure that a small portion of the film becomes detached and this should not interrupt operation of the handrail. If when  
20 inspecting the film, or replacing the film, it is noted that one or more portions of the film are missing and it is suspected that they have become attached to hidden parts of the drive mechanism, then this can be noted for investigation for a qualified maintenance team at a later date.

As noted above, the peel strength for a 5-inch width of film  
25 is approximately 35 pounds (155 Newtons). It is intended to provide perforations to weaken the film strength down to approximately 45 pounds (200 Newtons). This gives an adequate margin for enabling the film to be peeled off the handrail, while at the same time significantly weakening the film, down from the original strength of 250 pounds (1,112 Newtons). This  
30 avoids any excessive and unwanted loads being applied to any part of the drive and guidance mechanism.

Reference will now be made to Figures 17a, 17b which show

in detail alternative perforation patterns. It will be appreciated that any suitable perforation configuration can be provided. Indeed, it is conceivable that the arrangement of the perforations could be shaped according to advertising material placed on the film and even incorporated as part of the  
5 advertising material; otherwise the perforations are intended to be largely invisible to an ordinary user.

In all of Figures 17a-17d, a simple section of handrail is indicated, with the longitudinal axis of the handrail extending vertically in all these figures. It will be appreciated that the perforation pattern will be  
10 repeated at suitable intervals, for example, every 12 inches (30 cm).

Referring first to Figure 17a, a film is indicated at 260 and is provided with a diagonal line of perforations 262. Additionally, Figure 17a shows side margins 264. These were originally intended to provide unperforated zones at the edge of the film, in the belief that this was  
15 necessary to maintain sufficient film strength. In fact, it has been found that the opposite is the case; it is necessary to have significant perforations going the full width in order to reduce the film's strength down to a suitable level. For this reason, it is envisaged that unperforated side margins will likely not be provided.

20 The length of the slits and the gap between the slits can be varied and the following table gives some exemplary dimensions:

Slit Length (inches/mm)	Slit Gap (inches/mm)
0.05/1.3	0.2/5.1
0.05/1.3	0.4/10.2
0.05/1.3	0.8/20.3
0.025/0.6	0.8/20.3

Figure 17b shows a slight variation of Figure 17a. Here, the  
25 slits are longitudinal, although the line along which the slits or perforations

are located is again diagonal 45 degrees. The slits here are 0.2 inches long and spaced apart by 0.2 inches.

A further variant is shown in Figure 17c. Here, a line of perforations is provided, which comprises different line segments all running at 45 degrees to the longitudinal axis for the handrail, but in alternating directions. Slit lengths and slit gaps as in the table above could be employed in this configuration.

Figure 17c also shows another variant that can be employed with all the configurations for the perforations, namely the provision of two rows of longitudinally extending perforations 270 defining side margins. Here the side margins are relatively small at 0.0625 inches (1.6 mm), but the side margins could have varying dimensions and could be significantly larger, for example 0.25 inches (6.35 mm) or larger. More particularly, the side margins could be dimensioned so that a portion of the film that, in use covers just the top surfaces of the handrail is separated by these longitudinally extending perforations 270 from film that wraps underneath the bottom of the lips of the handrail.

Figure 17d, finally, shows a simple version of the perforations. Here, the perforations are arranged in a straight line 272 extending perpendicularly across the film. Again, slit lengths and slit gaps can be taken from the table given above. Longitudinally extending perforations 270 can optionally be included.

It is noted above that the film is ideally made from two layers of polyurethane with a thickness of 3 mil. It is now anticipated that the bottom layer of film could have a thickness of 2 mil and the top layer a thickness of 3 mil and conceivably, both layers could have a thickness of 2 mil. This will reduce the overall break strength of the film, and hence reduce the level of perforation required to reduce the break strength down to a reasonable figure, for safety purposes.

A further aspect of the present invention is to provide a flexible film for mounting on a handrail, to provide a cleaning function. Thus, rather than providing advertising or the like, it is envisaged that the

surface of the film could be provided with some coating to provide a cleaning function as it runs through the hidden and enclosed mechanism of an escalator or moving walkway. For this purpose, it will be appreciated that it is not necessary for the film to have two layers. With reference to the configuration of Figure 12, the layers 168 and 170, and optionally 172, could be omitted, i.e. at a minimum for this aspect of the invention, just a layer 162 (with different properties from those described above, as detailed below), an adhesive layer 164 and a release sheet 166 are required.

For example, in one embodiment, such a proposal could include an adhesive on the top surface of the film, i.e. similar to the layer 172 but with selected adhesive properties, intended to pick up fluff, dirt, lint and the like from within the escalator mechanism. For this purpose, the film would be mounted on the handrail as described above and the handrail operated for a desired period of time. The film would then be removed, taking with it any fluff, dirt, etc. picked upon the film. Other variants are envisaged. For example, the film could be provided with a porous or absorbent structure to absorb oils, greases and the like from surfaces within the handrail mechanism; this could be provided either by incorporating this characteristic into the single layer 162 or by providing a separate layer adhered to the film 162 by the adhesive layer 172. It is recognized that an inherent difficulty with such an approach is that the drive mechanism of many escalators imposes a strong pinch load on the handrail, which will naturally tend to squeeze out absorbed oils, greases and other fluids. For example, many escalators now employ a so-called linear drive which, by its very nature, requires a high pinch load, to provide an adequate drive.

For such installations, it is envisaged that an absorbent layer could be in the form of an open, porous absorbent material provided with longitudinally extending ribs or the like of relatively hard material. These ribs would be flush with the absorbent material, but would serve to transfer the pinch load of the rollers, to prevent excessive compression of the porous material, thereby preventing absorbed fluids and the like from



being expelled.

A further possibility is that a multi-layer film could be provided. For example, a bottom or main film could be provided with adhesive on both sides, so as to adhere to an escalator handrail on one side.

- 5 The adhesive on the other side could initially be bonded to an absorbent layer of material. Such a film would first be run so that the absorbent layer picks up oils, other fluids, etc. After a sufficient period of time, this absorbent layer would, separately, be removed, to leave the film itself and an exposed layer of adhesive. The film itself would then be run through the
- 10 drive mechanism, so that the exposed layer of adhesive picks up dirt, fluff and the like. The film would then be peeled off the escalator to remove the accumulated dirt, fluff, etc.

The presently preferred adhesive film only sticks properly to Hypalon rubber handrails. Hypalon is a chlorosulphonated rubber made

15 by DuPont, which has enhanced UV properties and is pigmentable. It is more expensive material, but is commonly selected where coloured handrails are required.

Most handrails are made with SBR (styrene butadiene rubber) because it has sufficient properties for most applications and is

20 cheaper. SBR can only be black. Adhesive film will initially stick, but will delaminate within days, if not hours because of the antioxidant component that leaches from SBR.

Hence, for the presently preferred adhesive, most escalator sites will require handrail replacement/upgrade to Hypalon prior to film

25 application. It may be possible to find a suitable adhesive that will bond adequately to SBR handrails.

It will be appreciated that while preferred embodiments of the invention have been described, numerous variations are possible within the scope of the invention as defined in the following claims.

30 In particular, the degree to which the film 160 wraps around the handrail can be adjusted and will depend on individual handrail profiles and installations. Having the film wrap a large way

- 32 -

around the handrail lips is advantageous as it puts the edge of the film well away from users and not readily accessible to anyone who, for whatever reason, might want to try and peel it off. On the other hand, where the film wraps all the way around the lips, it can tend to buckle as the handrail  
5 travels around end rollers and the like. Accordingly, it is expected that some compromise will usually be needed between these two parameters.

On a more general note, the film described herein can be applied to a stationary handrail as used in a normal stairwell.

**CLAIMS:**

1. A flexible film for applying to a handrail, the film comprising: a first film layer; a first layer of adhesive on the underside of  
5 the first film layer; a second film layer; and a second layer of adhesive bonding the underside of the second film layer to the top of the first film layer; wherein the film has a width corresponding to a handrail and is elongate, whereby the film can be cut to fit a selected handrail.
- 10 2. A film as claimed in claim 1, which includes a layer of printed matter on the top of the first film layer.
3. A film as claimed in claim 2, wherein the printed matter comprises a pattern repeated at regular intervals along the length of the  
15 film.
4. A film as claimed in claim 2, which includes an elongate release sheet of generally the same width as the film, protecting the first layer of adhesive.  
20
5. A film as claimed in claim 4, wherein each of the first and second film layers of the film comprises polyurethane with an approximate thickness of 3 mil.
- 25 6. A film as claimed in any one of claims 1 to 5, which includes, at regular intervals, means for weakening the film, to facilitate tearing of the film and removal of a portion of the film in an emergency.
7. A film as claimed in claim 6, wherein the means for  
30 weakening the film comprises lines of perforation extending through the film.

- 34 -

8. A film as claimed in claim 7, wherein the perforations extend at an inclined angle across the film.
9. A film as claimed in claim 8, which includes a pair of  
5 longitudinally extending lines of side perforations, and, at regular intervals, extending between the longitudinal lines of perforations, transverse lines of perforations.
10. A flexible film for applying to a handrail, the film  
10 comprising: a first film layer; a first layer of adhesive on the underside of the first film layer for adhering the film to a handrail, wherein the film has a width corresponding to a handrail and is elongate, whereby the film can be cut to fit a selected handrail, and wherein the film includes means for collecting contaminants from a moving handrail and associated drive  
15 mechanism.
11. A film as claimed in claim 10, which includes a second adhesive layer on an upperside of the first film layer, wherein the second adhesive layer is selected to cause fluff, fibres, particles of dirt and the like  
20 within a handrail drive mechanism to adhere to the second adhesive layer for removal from the drive mechanism.
12. A film as claimed in claim 11, which includes an absorbent layer bonded to the first film layer by the second adhesive layer, for  
25 absorbing unwanted fluids from a handrail drive mechanism.
13. A film as claimed in claim 12, wherein the absorbent layer additionally includes longitudinally extending ribs for substantially reducing the tendency of a handrail drive mechanism to compress the  
30 absorbent layer and thereby to squeeze out adsorbed fluids.
14. A film as claimed in claim 10 or 11, wherein the first film

layer is formed of absorbent material for absorbing unwanted fluids from a handrail drive mechanism.

15.           A film as claimed in claim 14, wherein the absorbent first  
5 film layer additionally includes longitudinally extending ribs for substantially reducing the tendency of a handrail drive mechanism to compress the absorbent first layer and thereby to squeeze out absorbed fluids.
- 10 16.           A flexible film for applying to a handrail, for one of changing the aesthetics of the handrail and rejuvenating the appearance of a used handrail, the flexible film comprising: a first film layer; a first layer of adhesive on the underside of the film, wherein the film has a width corresponding to a handrail and is elongate, whereby the film can be cut to  
15 fit a selected handrail.
17.           A film as claimed in claim 16, wherein the first film layer has one of a solid colour and a repeated pattern.
- 20 18.           A film as claimed in claim 17, which includes printed matter on the underside of the film with the first layer of adhesive provided underneath the printed matter.
19.           In combination, an elongate handrail and a flexible film  
25 adhered to the handrail, the film comprising: a first film layer and a first layer of adhesive between the first film layer and the handrail, bonding the first film layer to the handrail.
20.           A combination of a handrail and a film as claimed in claim  
30 19, wherein the film extends around the outer surfaces of the shoulder of the handrail to cover lips of the handrail.

- 36 -

21. A combination of a handrail and a film as claimed in claim 20, wherein the film includes a second film layer and a second layer of adhesive bonding the second film layer on top of the first film layer.

5 22. A combination of a handrail and a film as claimed in claim 21, which includes printed matter on top of the first film layer, between the first film layer and the second layer of adhesive.

23. A combination of a handrail and a film as claimed in claim  
10 22, wherein the printed matter comprises a pattern repeated at regular intervals along the length of the film.

24. A combination of a handrail and a film as claimed in any  
one of claims 19 to 23, wherein the first film layer has one of a solid colour  
15 and a repeated pattern.

25. A combination as claimed in claim 21 or 22, wherein each  
layer of the film comprises polyurethane with an approximate thickness of  
3 mil.

20

26. A combination of a handrail and a film as claimed in claim  
25, wherein the handrail comprises a continuous loop of handrail, intended  
to be driven in use on an escalator or moving walkway, and wherein the  
film includes end portions which overlap one another to form a spliced  
25 joint.

27. A combination of a handrail and a film as claimed in claim  
26, wherein the film extends around the outside of the handrail and  
partially covers the lips of the handrail.

30

28. A combination as claimed in claim 20, wherein the  
handrail comprises a fixed, stationary handrail.

29. A combination as claimed in any one of claims 19 to 28, which includes, at regular intervals, means for weakening the film, to facilitate tearing of the film and removal of a portion of the film in an  
5 emergency.

30. A combination as claimed in claim 29, wherein the means for weakening the film comprises lines of perforation.

10 31. A combination as claimed in claim 30, wherein the perforations extend at an inclined angle across the film.

32. A combination as claimed in claim 31, which includes a pair of longitudinally extending lines of side perforations, and, at regular  
15 intervals, extending between the longitudinal lines of perforations, transverse lines of perforations.

33. An apparatus for applying an adhesive film to a moving handrail, the apparatus comprising: mounting means for mounting the  
20 apparatus to a balustrade; a first spindle means, for mounting a first roll of film; and a pressure means for applying pressure to the film to cause the film to adhere to the handrail, whereby, in use, the handrail can be driven past the apparatus, causing the film to be unrolled from the first roll with the means for applying pressure causing the film to adhere to the handrail.

25

34. An apparatus as claimed in claim 33, wherein the pressure means comprises at least one roller.

35. An apparatus as claimed in claim 33, which includes  
30 adjustment means for adjusting the position of the first spindle means relative to the mounting means.

- 38 -

36. An apparatus as claimed in claim 33, wherein the mounting means comprises suction cups for vacuum attachment of the apparatus to a smooth surface of a balustrade.

5 37. An apparatus as claimed in claim 33, wherein the mounting means comprises clamping means for clamping the apparatus to a balustrade.

38. An apparatus as claimed in claim 35, which includes a  
10 second spindle means, on which a second roll, for taking up a release sheet, is mounted in use and a drive means between the first and second spindle means, whereby unwinding of film from a roll on the first spindle means causes the first spindle means to drive the second spindle means, thereby causing the second spindle means to take up a release sheet separated from  
15 film leaving the first roll.

39. An apparatus as claimed in claim 38, wherein the drive means comprises a gear train.

20 40. An apparatus as claimed in claim 39, wherein the gear train includes a ratio of speeds between the first and second spindles such that the second spindle means is always driven at a speed faster than required to wind up the release sheet, and wherein the apparatus includes clutch means in at least one of the first and second spindle means, to dissipate  
25 excess speed.

41. An apparatus as claimed in claim 40, wherein the apparatus includes a main body secured to the mounting means, wherein the first and second spindle means are pivotally mounted to a swing arm pivotally  
30 mounted to the main body, and wherein the pressure means includes a main roller pivotally mounted relative to the longitudinally extending member.



42. An apparatus as claimed in claim 41, which includes spring biasing means for biasing the main roller towards the top of an escalator handrail.

5

43. An apparatus as claimed in claim 38, which includes adjustable support means, extending from the mounting means to the main body, the adjustable support means enabling adjustment of the location of the main body, both horizontally and vertically in a plane perpendicular to the handrail.

10

44. An apparatus as claimed in claim 43, wherein the adjustable support means includes an upwardly extending member connected to the mounting means, a first cross member, a first pivot connection between the first cross member and the upwardly extending member, a sliding swivel joint slidable along the first cross member and securable thereto, a second cross member, a second pivot connection pivotally connecting the second cross member to the sliding pivot joint and a downwardly extending member extending downwardly from the second cross member to the main body.

20

45. An apparatus as claimed in claim 42, wherein the pressure means includes a pressing mechanism including a plurality of pairs of rollers mounted symmetrically about the centre line of the pressing mechanism, corresponding to a centre line of a handrail, the pairs of rollers extending from a rearward end of pressing mechanism to a forward end thereof, the rearward and forward ends corresponding to the direction of motion of a handrail, wherein a rearward pair of rollers are mounted adjacent to the centre line of the mechanism, and each successive pair of rollers, towards the forward end of the pressing mechanism, is mounted progressively further apart, whereby as a handrail passes through the pressing mechanism, the film is progressively wrapped around the outer

30

surface of the lips of the handrail from the centre line of the handrail, and wherein the pressing mechanism is located forwardly of the main roller.

46. An apparatus as claimed in claim 45, wherein the pressing  
5 mechanism comprises a generally trough-shaped member comprising a pair  
of trough-shaped element halves, symmetrical about the centre line of the  
apparatus, and wherein the apparatus includes a mechanism for opening  
the trough-shaped element to displace the halves laterally, to permit  
mounting on a handrail, and enabling closing of the trough-shaped  
10 element to locate the trough-shaped element around a handrail with the  
rollers abutting the handrail surface.

47. An apparatus for removing an adhesive film from a  
moving handrail, the apparatus comprising:  
15 mounting means for mounting the apparatus to a  
balustrade;  
a first spindle means for mounting a take-up roll;  
a drive cylinder pivotally mounted to the apparatus;  
means for pressing the drive cylinder against a handrail, to  
20 receive a drive input when the handrail is in motion;  
transmission means connecting the drive cylinder to the  
first spindle means, for driving a take-up roll mounted on the first spindle  
means to wind up a film from the handrail.

25 48. An apparatus as claimed in claim 47, wherein the  
transmission means comprises a gear train between the cylinder and the  
first spindle means.

49. An apparatus as claimed in claim 48, wherein the gear train  
30 is sized to drive the first drive cylinder with a higher circumferential  
velocity than the velocity of the handrail and wherein the transmission  
means includes a clutch permitting slippage and for maintaining a

substantially constant torque on the take-up roll.

50. An apparatus as claimed in claim 47, 48 or 49, wherein the drive drum is movably mounted relative to a main support member of the apparatus, and wherein the transmission means and the first spindle are mounted on a swing arm pivotally mounted with respect to the drive drum, whereby, in use, the drive drum is pressed against the surface of the handrail, and the take-up roll on the first spindle rests on the surface of the handrail.

10

51. An apparatus as claimed in 47, 48, 49 or 50, in combination with an apparatus as claimed in any one of claims 33 to 44.

52. A method of applying a flexible film to a moving handrail, the method comprising:

- (1) providing a film comprising a first film layer and first layer of adhesive on the underside thereof, the film being generally elongate and having width corresponding to the width of the handrail;
- (2) aligning and adhering a first end of the film to a surface of the handrail;
- (3) driving the handrail relative to the film, to cause the film to adhere continuously and progressively to the handrail; and
- (4) ensuring that the full width of the film is uniformly and smoothly adhered to the surface of the handrail.

25

53. A method as claimed in claim 52, which includes providing the film on a first roll and mounting the first roll on a first spindle adjacent the handrail, and in step (3) applying a roller to the surface of the handrail to press the film against the handrail.

30

54. A method as claimed in claim 53, which includes providing a film having a width sufficient to wrap around the outer edge of the

handrail, the method including progressively wrapping the film around the lips of the handrail by means of a plurality of pairs of rollers, each pair of rollers being mounted successively further apart and around the outside of the handrail.

5

55. A method as claimed in claim 54, which includes:

- (a) providing the film with a release sheet;
- (b) providing a second roll for taking up the release sheet; and

10

(c) as the film is applied to the handrail, winding up the release sheet, as it is separated from the film, on the second roll.

56. A method as claimed in claim 55, which includes providing a second spindle for the second roll, and a drive mechanism and clutch mechanism between the first and second spindles, whereby the second spindle is provided with a torque to maintain a substantially constant tension in the release sheet during the winding thereof.

15

57. A method as claimed in claim 56, which includes providing the spindles on an apparatus, including means for mounting the apparatus to a balustrade and adjustment means, the method comprising first mounting the apparatus to the balustrade and adjusting the location of the spindles vertically, horizontally and angularly with respect to the adjustment means to align the roll of film with the handrail.

25

58. A method as claimed in claim 57, the method including providing: forwardly of the main roller, a pressing mechanism including said plurality of pairs of rollers mounted symmetrically about a centre line of the handrail, the pairs of rollers extending from a rearward end of the pressing mechanism to a forward end thereof, the rearward and forward ends corresponding to the direction and motion of a handrail, wherein a rearward pair of rollers are mounted adjacent to the centre line of the

30

apparatus, and each successive pair of rollers, towards the forward end of the pressing mechanism, is mounted progressively further apart; the method further comprising displacing the pairs of rollers apart to permit the pressing mechanism to be fitted around the handrail and engaging the  
5 pairs of rollers against the surface of the handrail, whereby as a handrail passes through the pressing mechanism, the film is progressively wrapped around the outer surface of the lips of the handrail.

59. A method of removing an adhesive film mounted on a  
10 handrail, the handrail being mounted for movement relative to a balustrade, and the method comprising:

- (1) mounting an apparatus to the balustrade including a drive cylinder and a spindle for a take-up roll;
- (2) mounting a take-up roll on the spindle and pressing  
15 the drive cylinder against the surface of the handrail;
- (3) manually detaching an end portion of the adhesive film and engaging the end portion with the take-up roll;
- (4) driving the handrail, thereby to transfer drive to the drive cylinder, and in turn to cause rotation of the take-up roll to wind up  
20 the adhesive film;
- (5) after the entire adhesive film has been removed from the handrail, stopping the handrail and removing the roll with the wound up adhesive film from the apparatus.

25 60. A method as claimed in claim 59, wherein step (4) comprises providing a separate external drive for the take-up roll.

61. A method of removing contaminants from a drive mechanism of a handrail, the handrail being mounted for movement  
30 relative to a balustrade and the drive mechanism being incorporated into the balustrade, and the method comprising:

- (1) mounting a film to the handrail, the film

- comprising: a first film layer; a first layer of adhesive on the underside of the first film layer for adhering the film to a handrail the film having a width corresponding to the handrail and being elongate, and the film including means for collecting contaminants from a moving handrail and
- 5 associated drive mechanism;
- (2) driving the handrail to cause the film to pass through the drive mechanism, thereby to cause contaminants to be picked up by the film;
- (3) after a period of time, stopping the handrail and
- 10 removing the film from the handrail.

62. A method as claimed in claim 61, which includes providing a second adhesive layer on an upperside of the first film layer, wherein the second adhesive layer is selected to cause fluff, fibres, particles of dirt and

15 the like on a handrail drive mechanism, guide rollers, support rollers and associated ancillary equipment to adhere to the second layer for removal from the above mentioned equipment during step (2).

63. A method as claimed in claim 62, which includes providing

20 an absorbent layer bonded to the first film layer by the second layer of adhesive, for absorbing unwanted fluids from a handrail drive mechanism, guide rollers, support rollers and associated ancillary equipment

64. A method as claimed in claim 63, which includes providing

25 the absorbent layer with longitudinally extending ribs for substantially reducing the tendency of a handrail drive mechanism to compress the absorbent layer and thereby to squeeze out adsorbed fluids, during step (2).

65. A method as claimed in claim 61, which includes forming

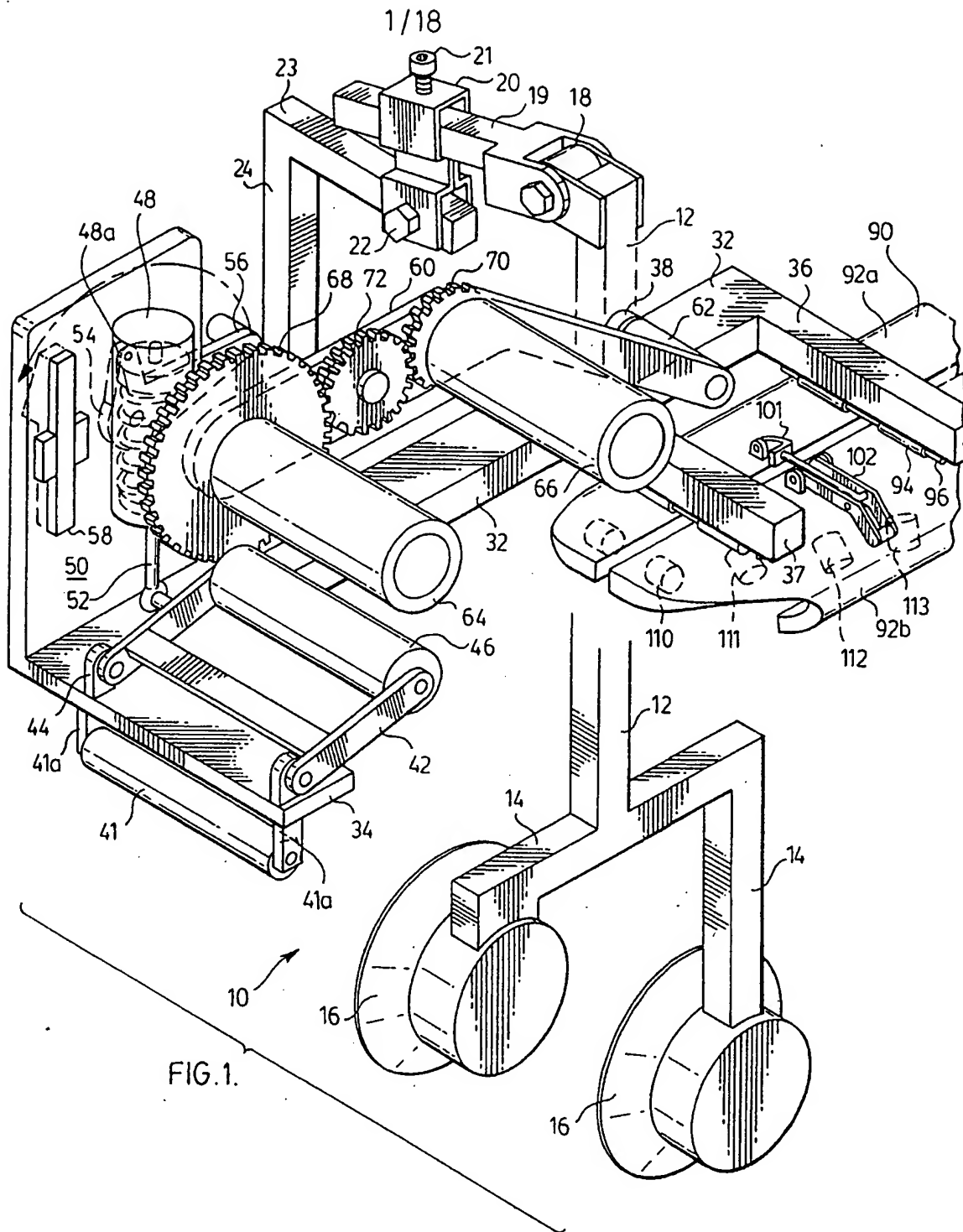
30 the first film layer from an absorbent material for absorbing unwanted fluids from the handrail drive mechanism.

66. A method as claimed in claim 65, which includes providing the absorbent first film layer with longitudinally extending ribs for substantially reducing the tendency of a handrail drive mechanism to compress the absorbent first layer and thereby to squeeze out adsorbed  
5 fluids.

67. A method as claimed in any one of claims 61 to 66, which includes mounting the film to the handrail in step (1) with an apparatus as claimed in any one of claims 33 to 46.  
10

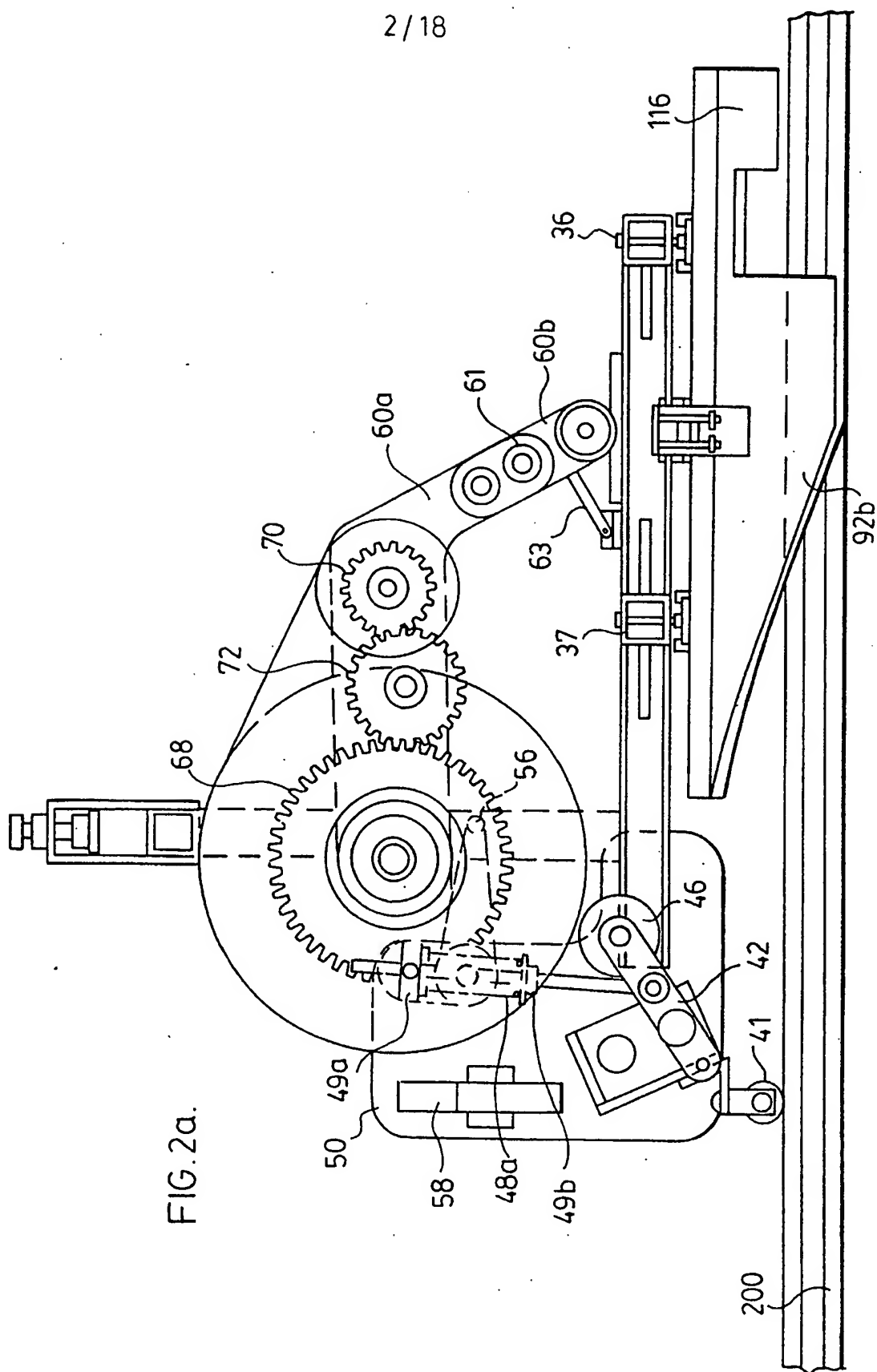
68. A method as claimed in any one of claims 61 to 67, which includes removing the film in step (3) with an apparatus as claimed in any one of claims 47 to 50.

15 69. A method as claimed in any one of claims 61 to 66, which includes mounting the film in step (1) and removing the film in step (3) with an apparatus as claimed in claim 51.





2/18



3/18

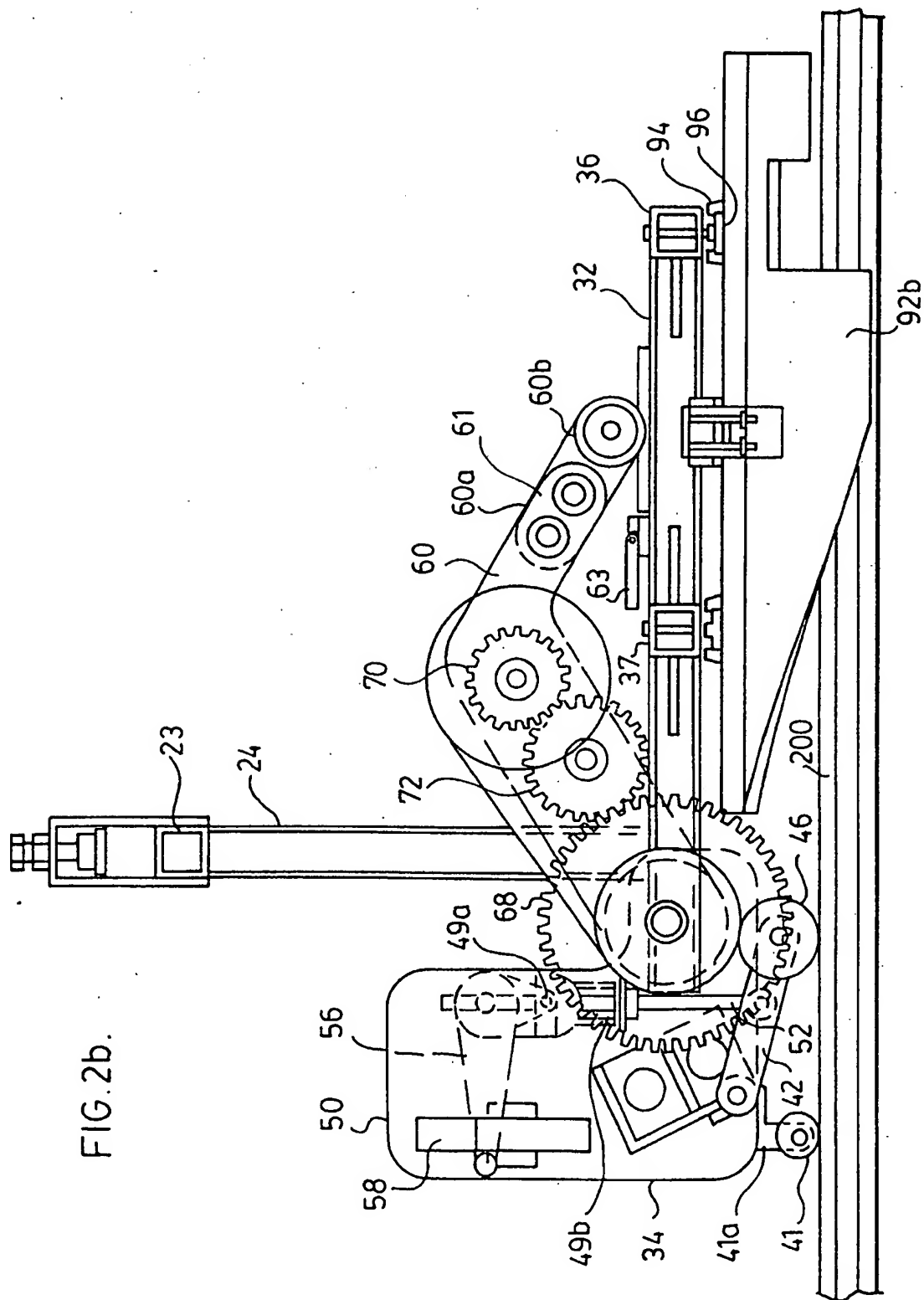


FIG. 2b.

4/18

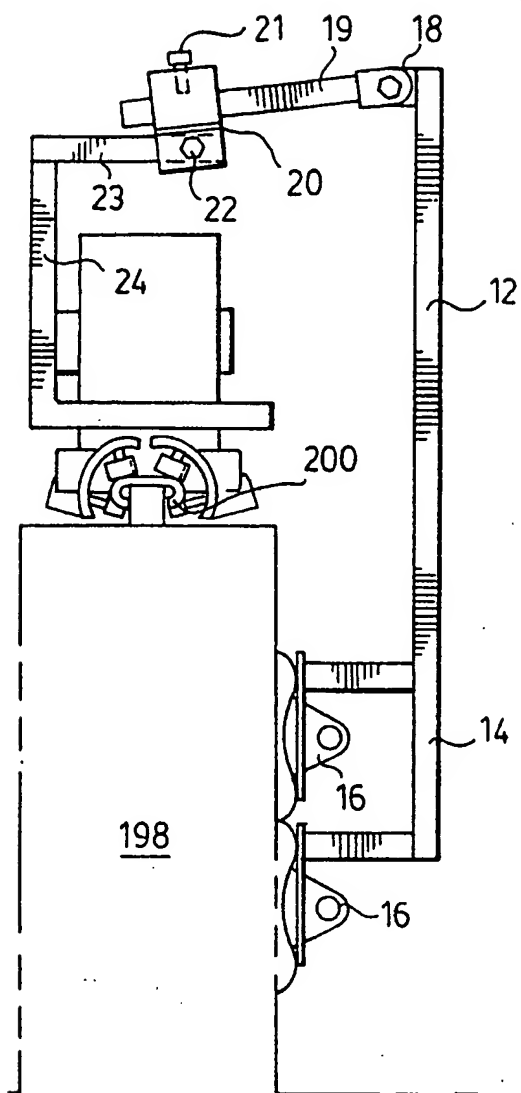


FIG. 3a.

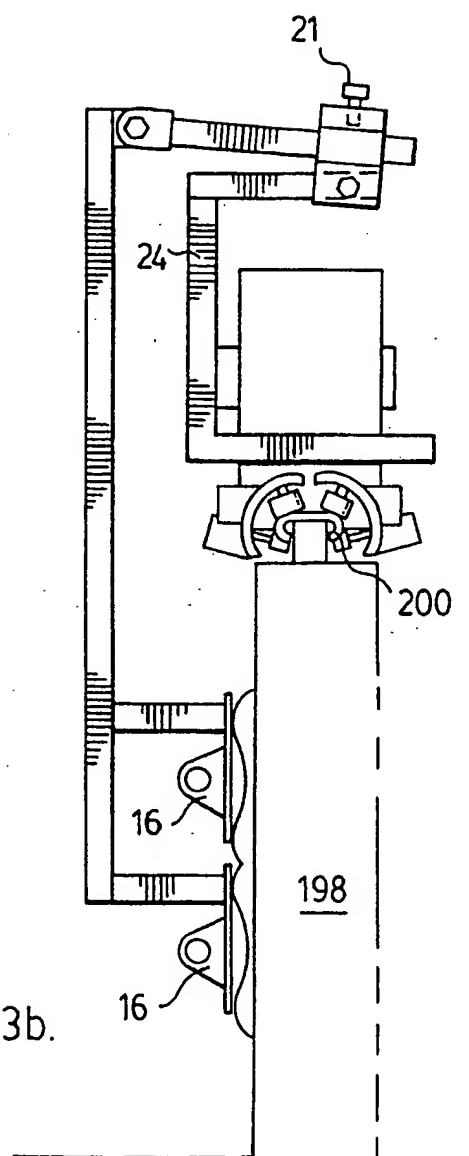


FIG. 3b.

5/18

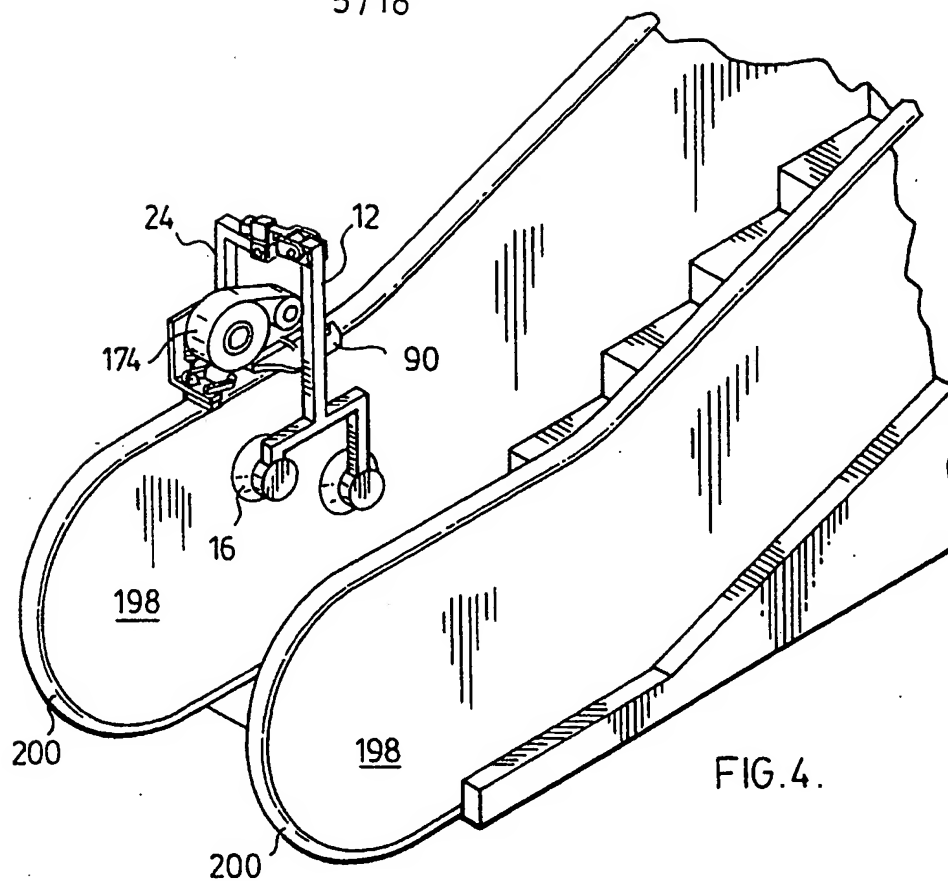
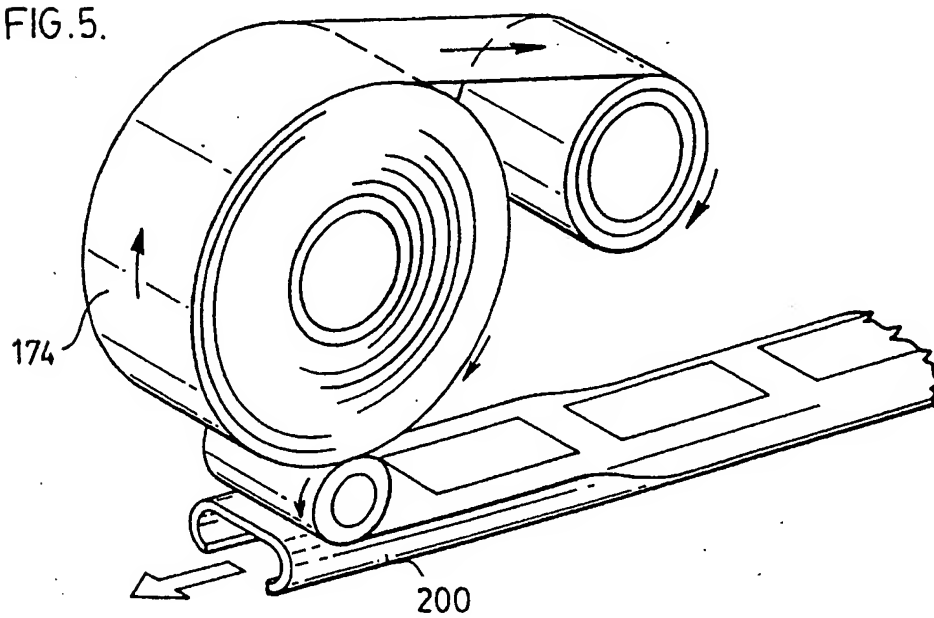


FIG. 5.



6/18

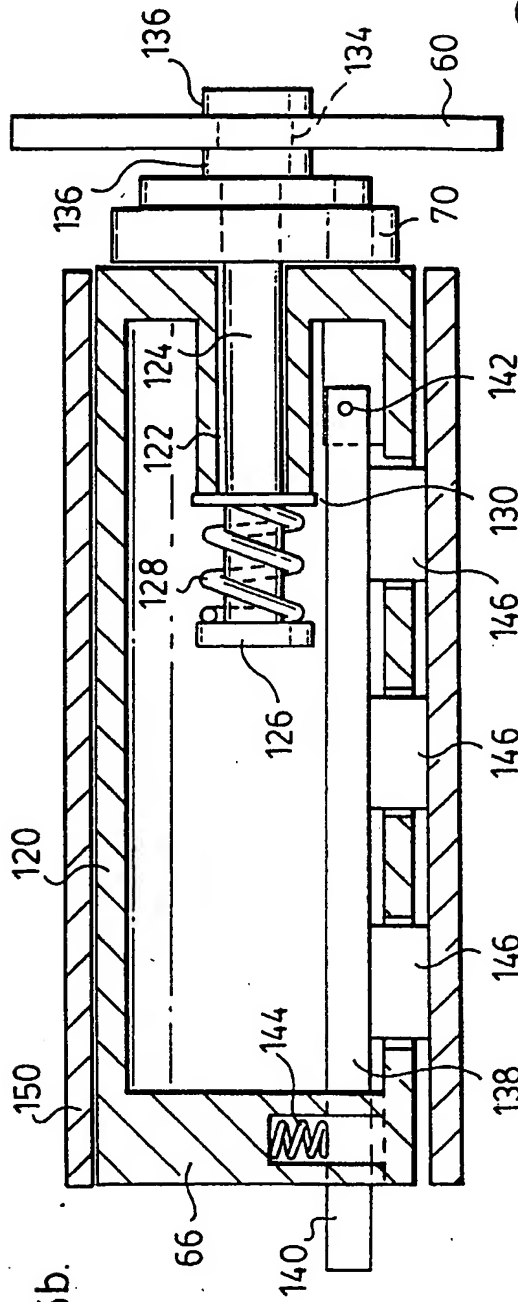


FIG. 6b.

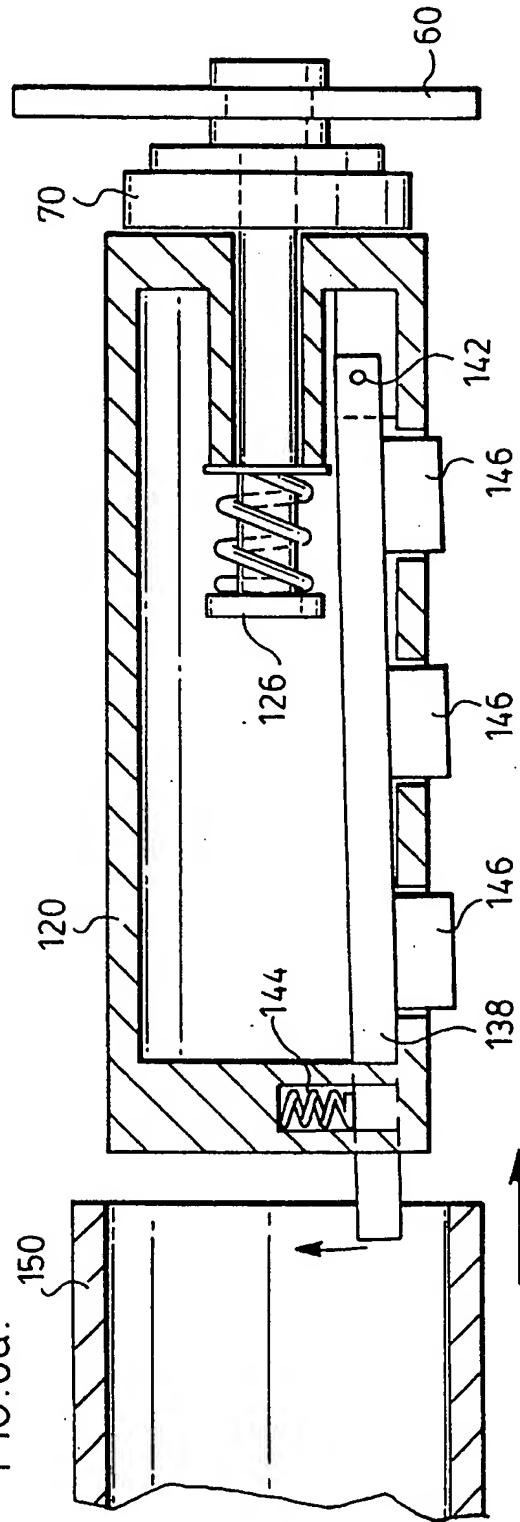
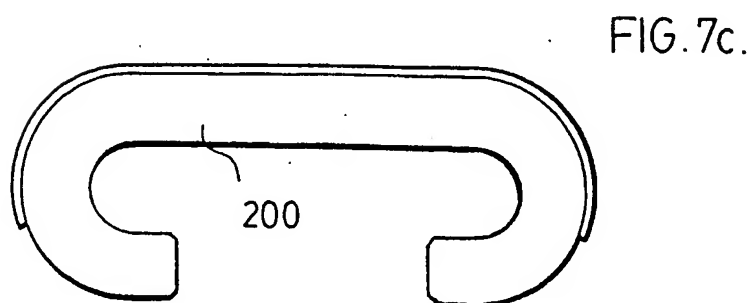
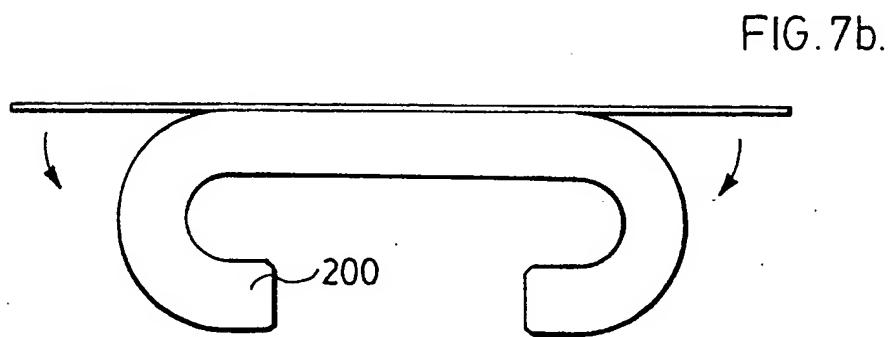
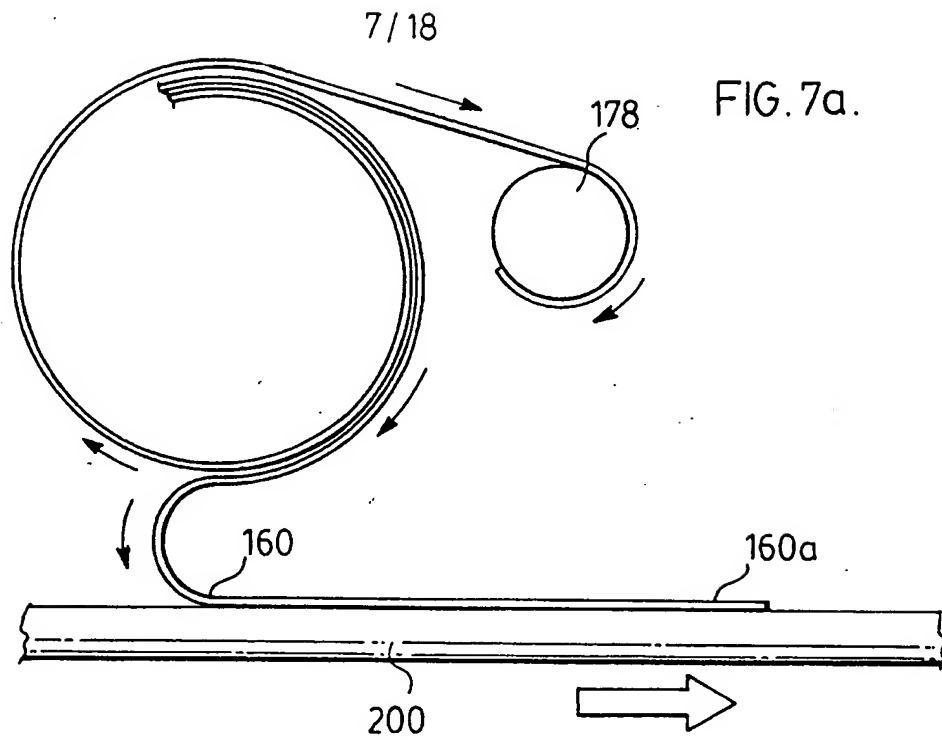
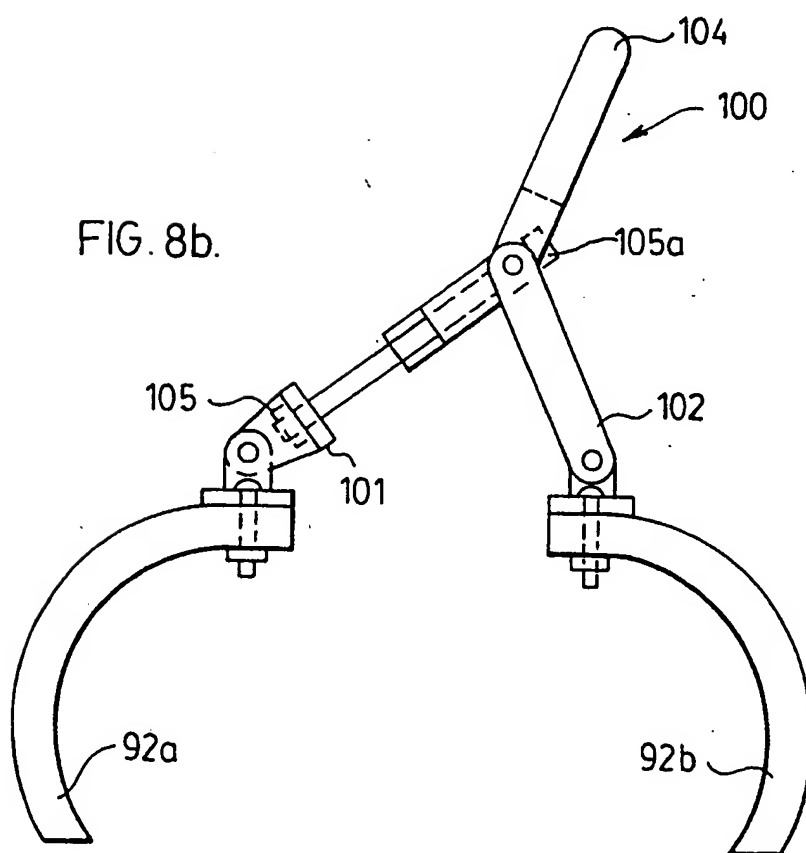
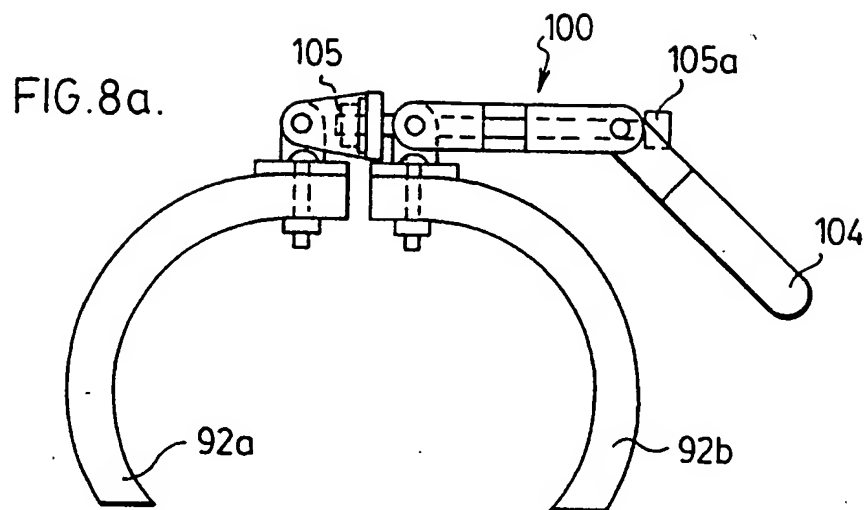
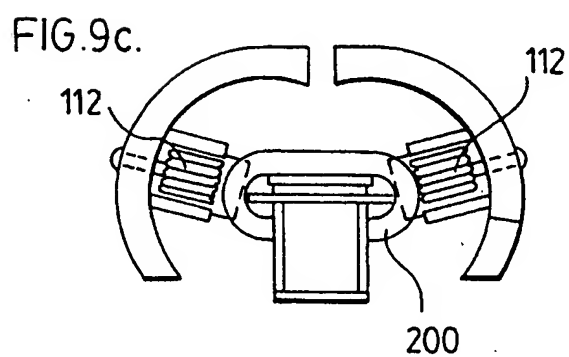
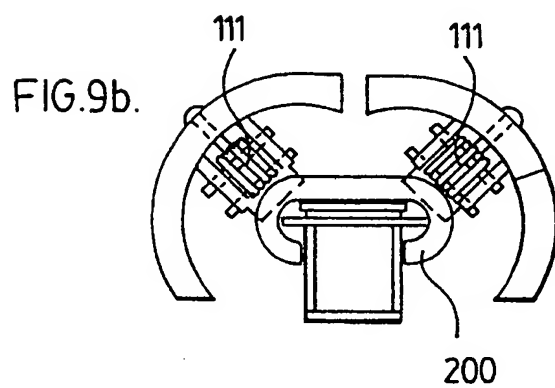
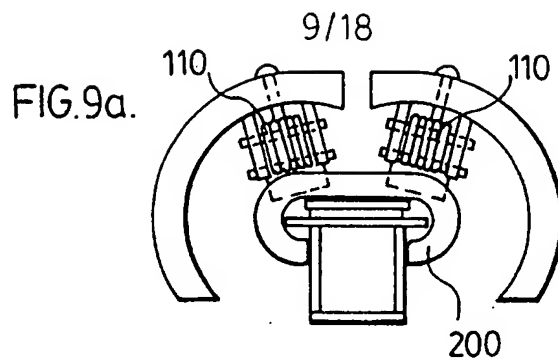


FIG. 6a.



8 / 18







10 / 18

FIG. 9d.

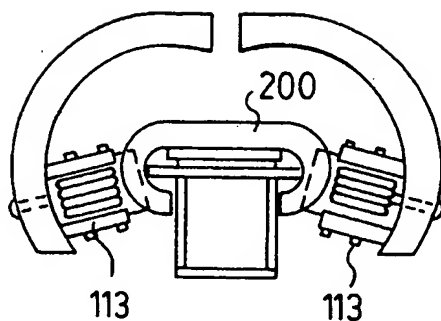


FIG. 9e.

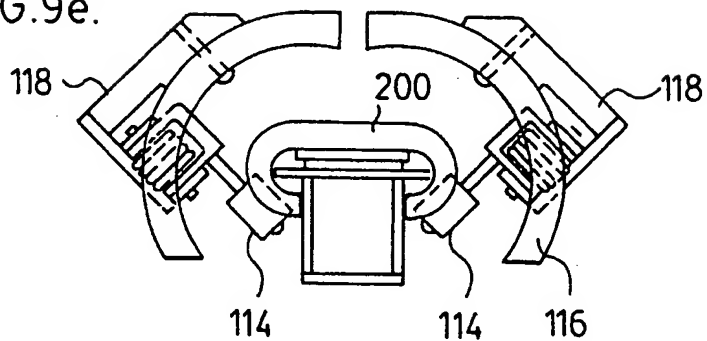
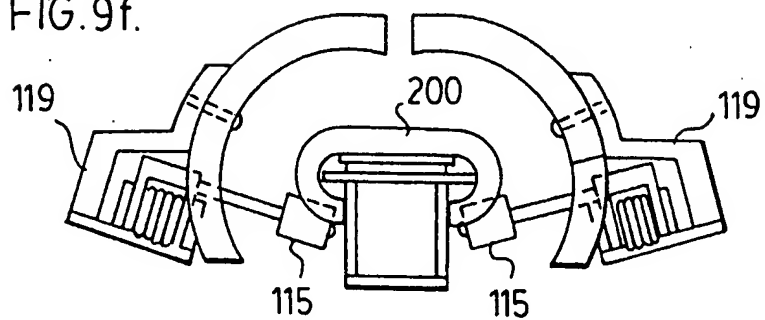
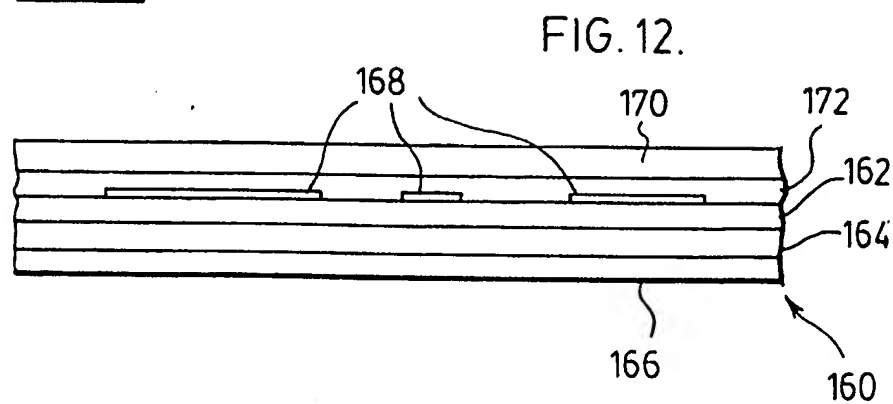
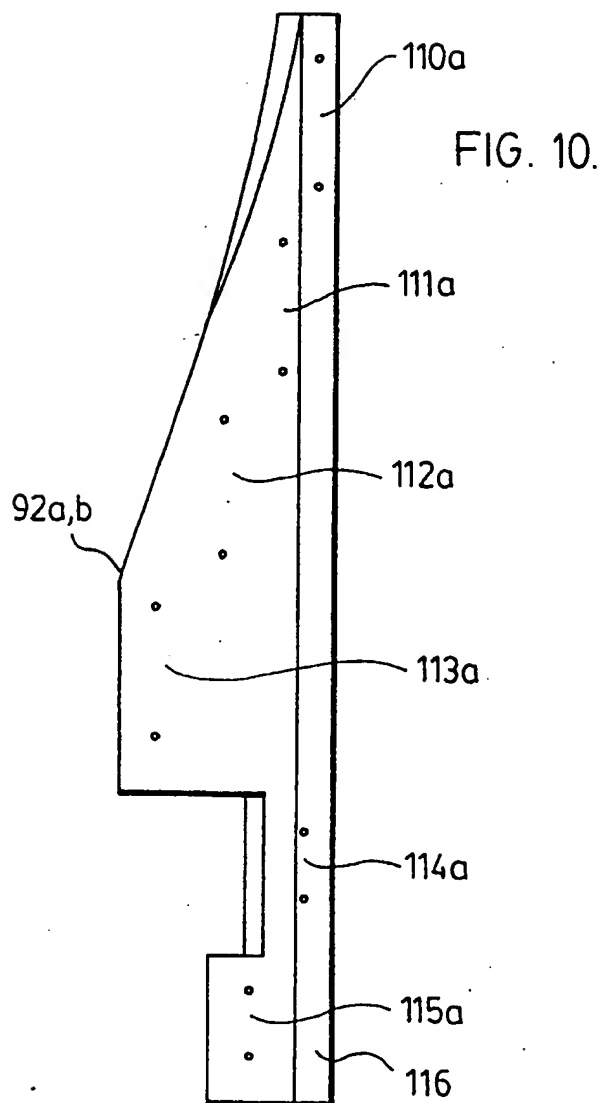


FIG. 9f.



11 / 18



12/18

FIG. 11a.

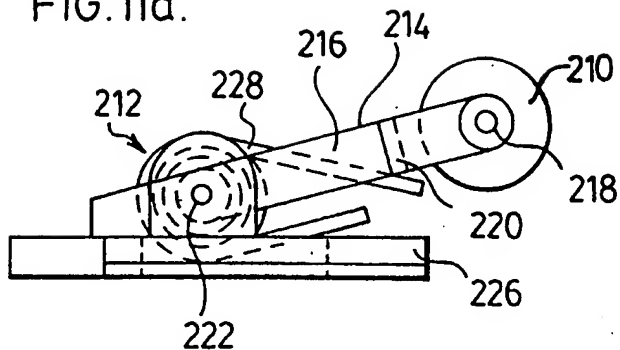


FIG. 11d.

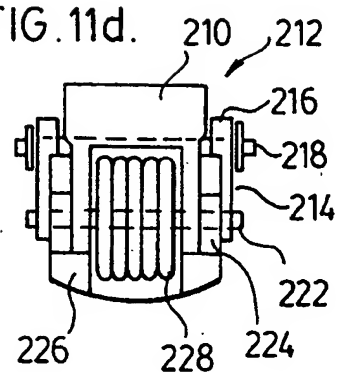


FIG. 11b.

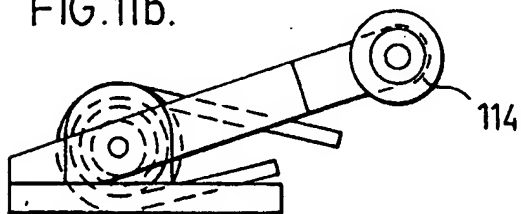


FIG. 11e.

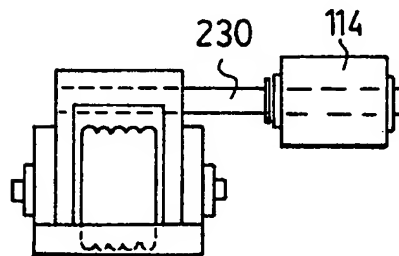


FIG. 11c.

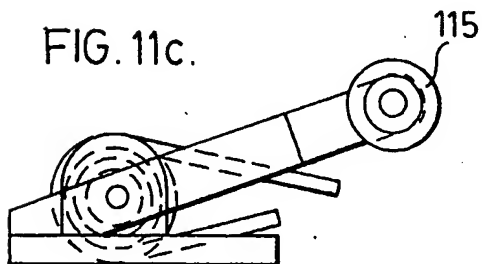
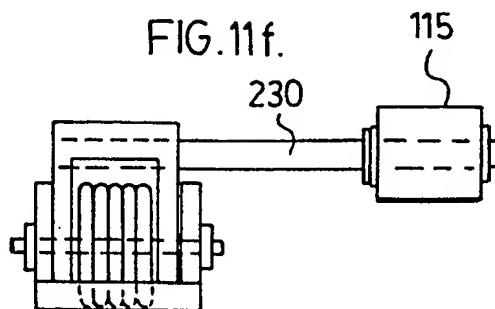


FIG. 11f.



13 / 18

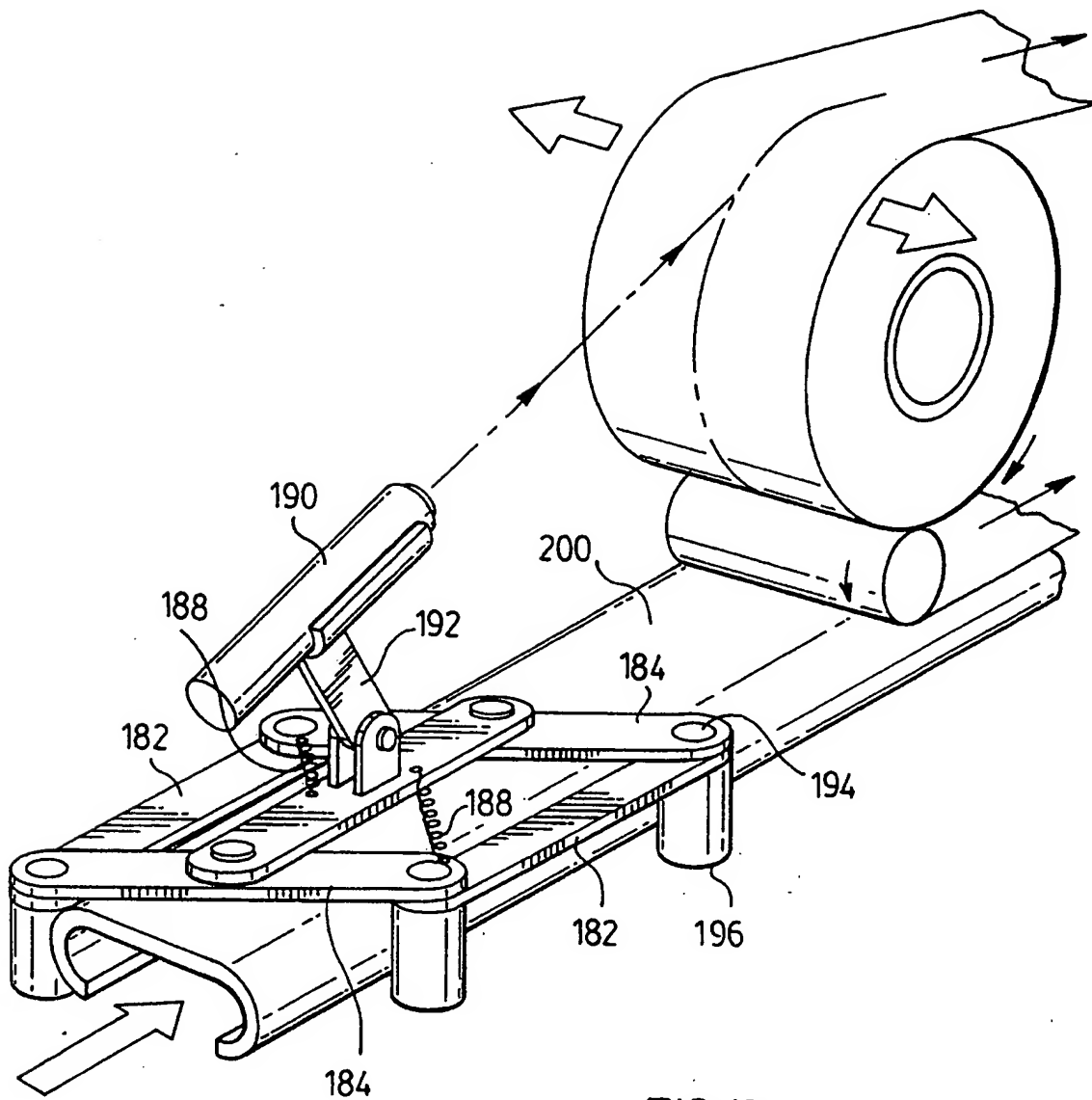


FIG. 13.

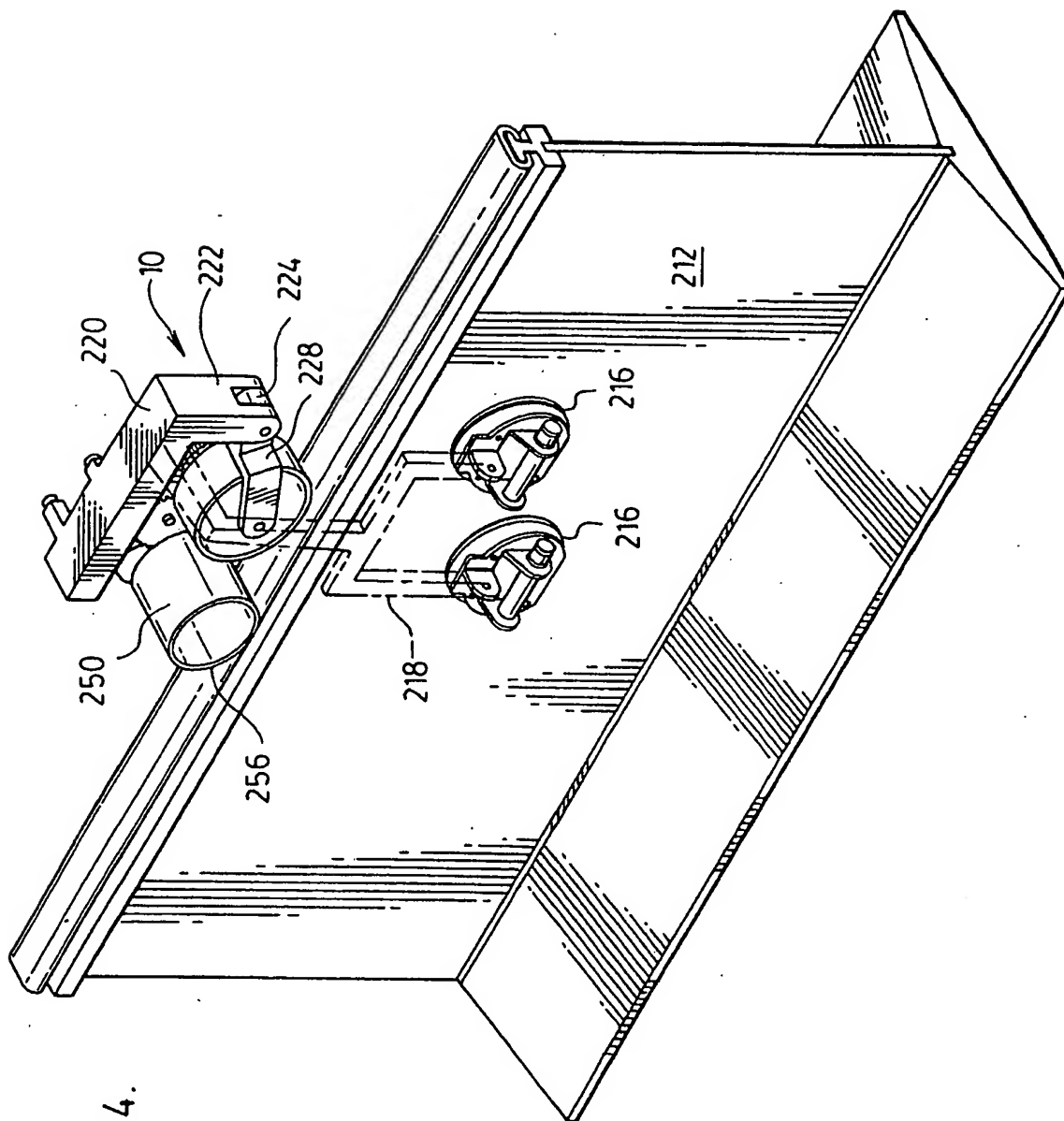


FIG. 14.

15 / 18

FIG. 15a.

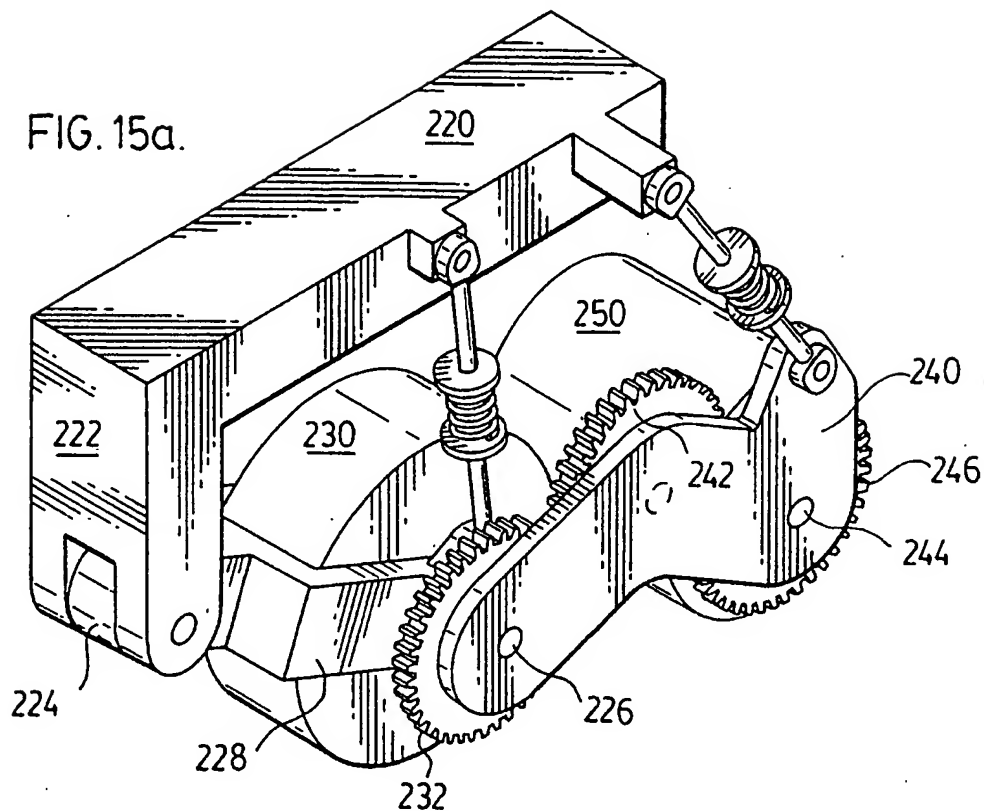


FIG. 15b.

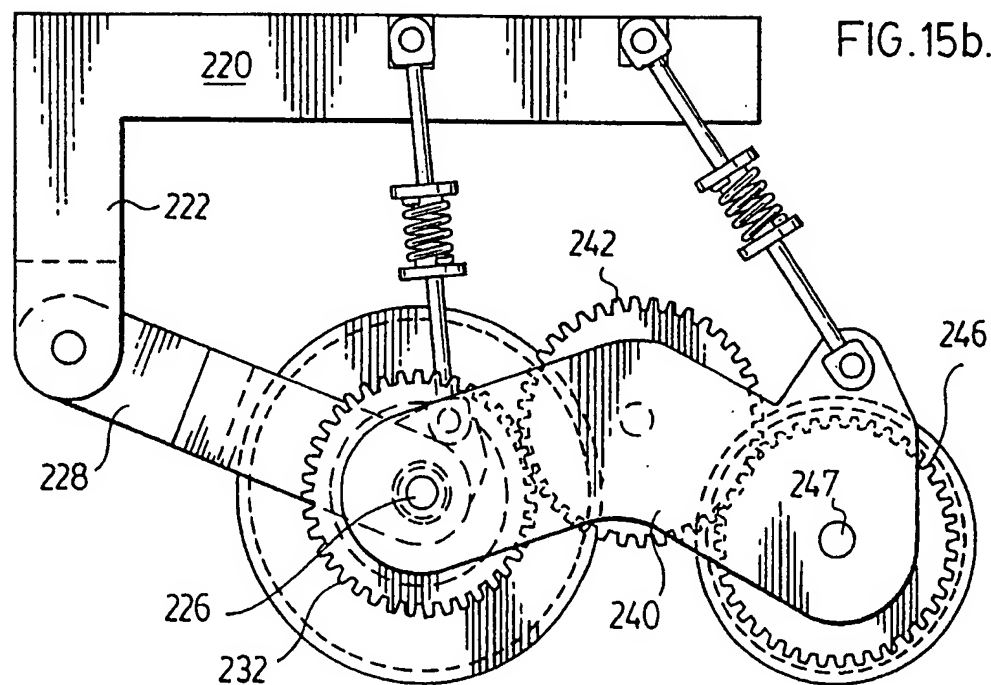
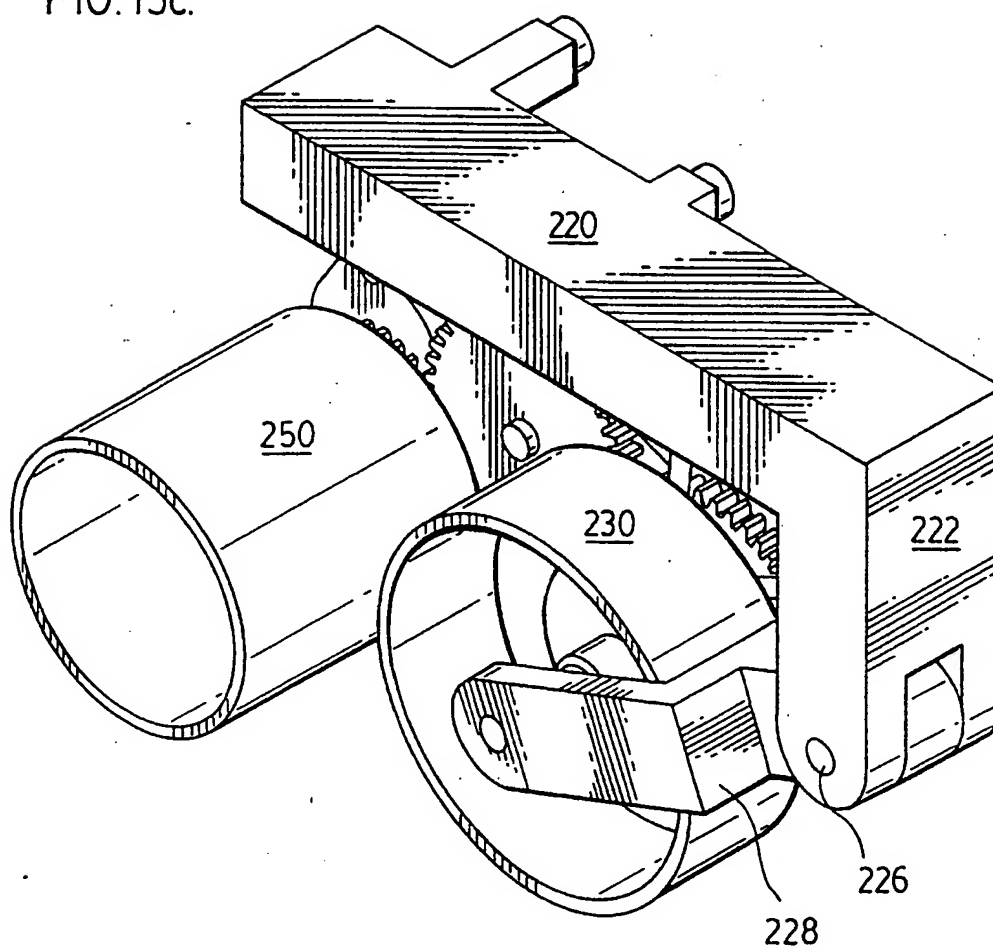
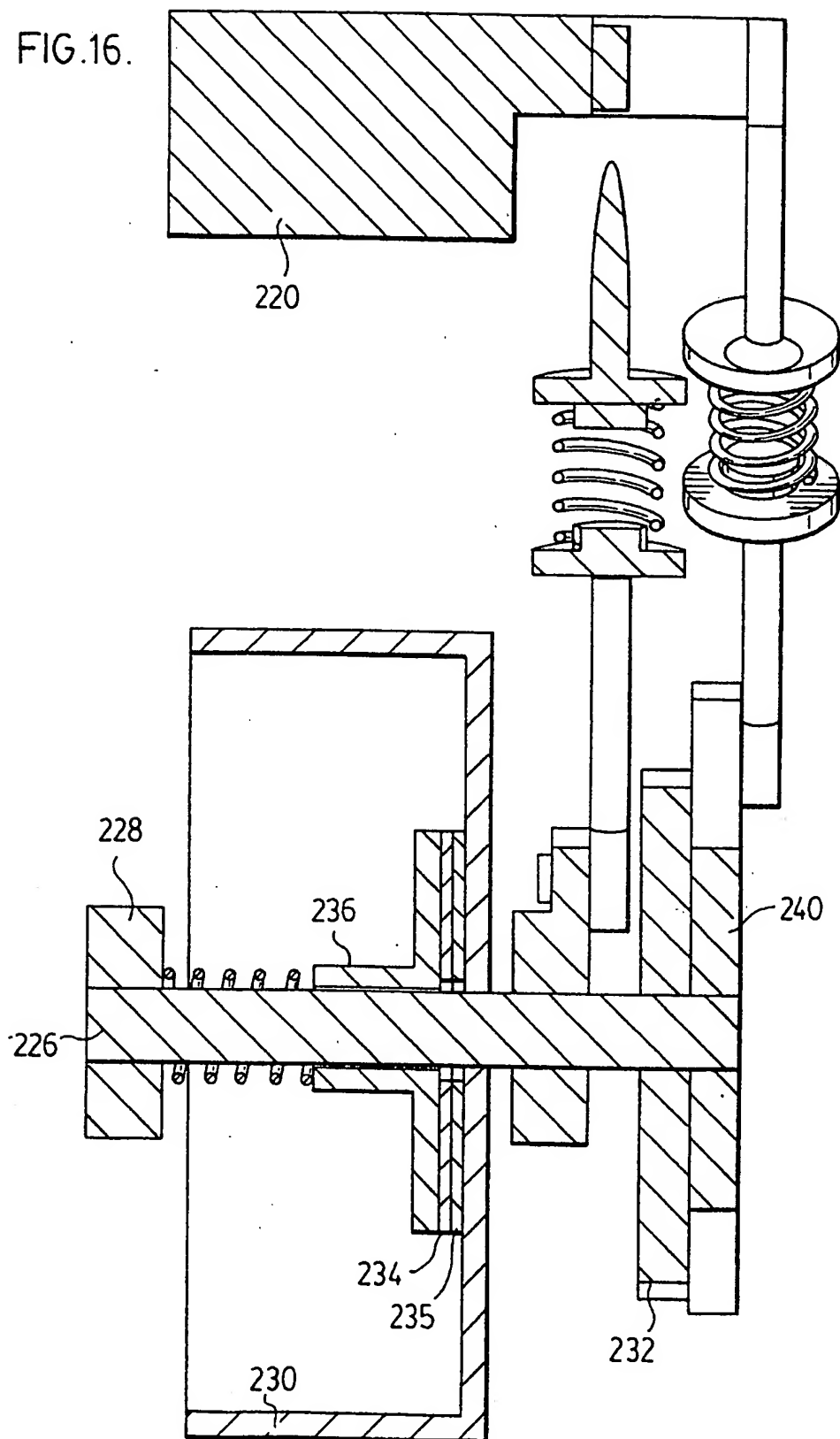


FIG. 15c.



17/18

FIG.16.





18/18

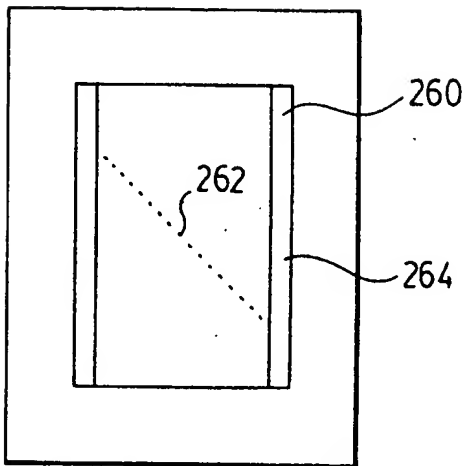


FIG. 17a.

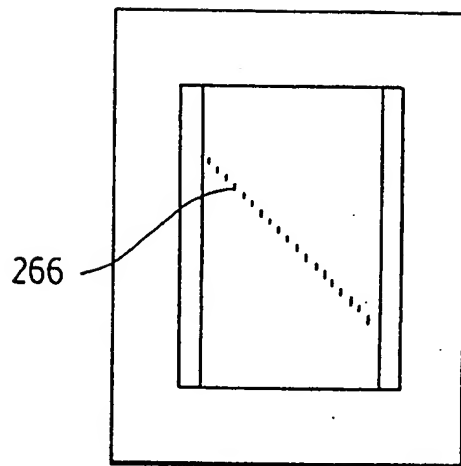


FIG. 17b.

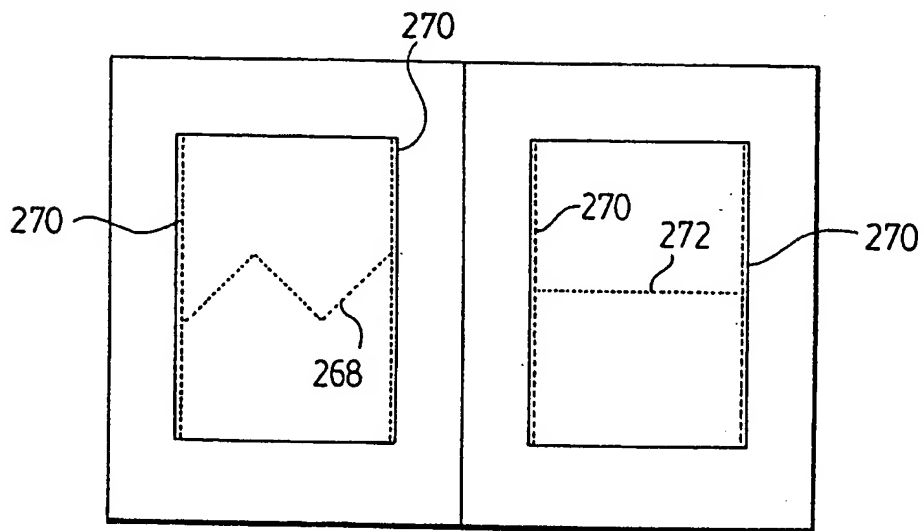


FIG. 17c.

FIG. 17d.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 00/00166

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 B66B23/24 G09F19/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B66B G09F B65H B44C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 728 377 A (SCHWARTZ DAVID) 21 June 1996 (1996-06-21) the whole document	1, 16, 19
A		2-15, 17, 18, 20-69
Y	US 5 020 256 A (FRENCH ANDREW B) 4 June 1991 (1991-06-04) the whole document	1, 16, 19
A		2-15, 17, 18, 20-69
A	GB 2 293 478 A (GANG QIN) 27 March 1996 (1996-03-27) the whole document	1-69
	--- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 June 2000

Date of mailing of the international search report

29/06/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax: (+31-70) 340-3016

Authorized officer

Hauser, L

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 00/00166

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 225 (M-1122), 10 June 1991 (1991-06-10) & JP 03 066887 A (IIDA TSUSHO KK), 22 March 1991 (1991-03-22) abstract ---	1-69
A	DE 298 11 446 U (KOSMERIDIS SAVVAS ;NOVRATIDIS THEOFILOS (DE)) 1 October 1998 (1998-10-01) the whole document ---	1-69
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 11, 26 December 1995 (1995-12-26) & JP 07 206352 A (AKEMASA YONEDA), 8 August 1995 (1995-08-08) abstract ---	1-69
A	FR 2 610 751 A (ABOUAF ALAIN) 12 August 1988 (1988-08-12) the whole document -----	1-69

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 00/00166

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2728377	A	21-06-1996	NONE	
US 5020256	A	04-06-1991	AT 100619 T	15-02-1994
			AU 614286 B	29-08-1991
			AU 1728388 A	21-12-1988
			WO 8809545 A	01-12-1988
			CA 1304035 A	23-06-1992
			DE 3887277 D	03-03-1994
			DE 3887277 T	25-08-1994
			DK 25089 A	20-01-1989
			EP 0316384 A	24-05-1989
			FI 890218 A	16-01-1989
			HK 1005894 A	29-01-1999
			JP 2500137 T	18-01-1990
			JP 2813608 B	22-10-1998
			KR 9610769 B	08-08-1996
			NO 179347 B	10-06-1996
			NZ 224711 A	26-10-1990
GB 2293478	A	27-03-1996	NONE	
JP 03066887	A	22-03-1991	NONE	
DE 29811446	U	01-10-1998	NONE	
JP 07206352	A	08-08-1995	NONE	
FR 2610751	A	12-08-1988	NONE	